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PUBLIC WORKS

CITY COUNTY STATE

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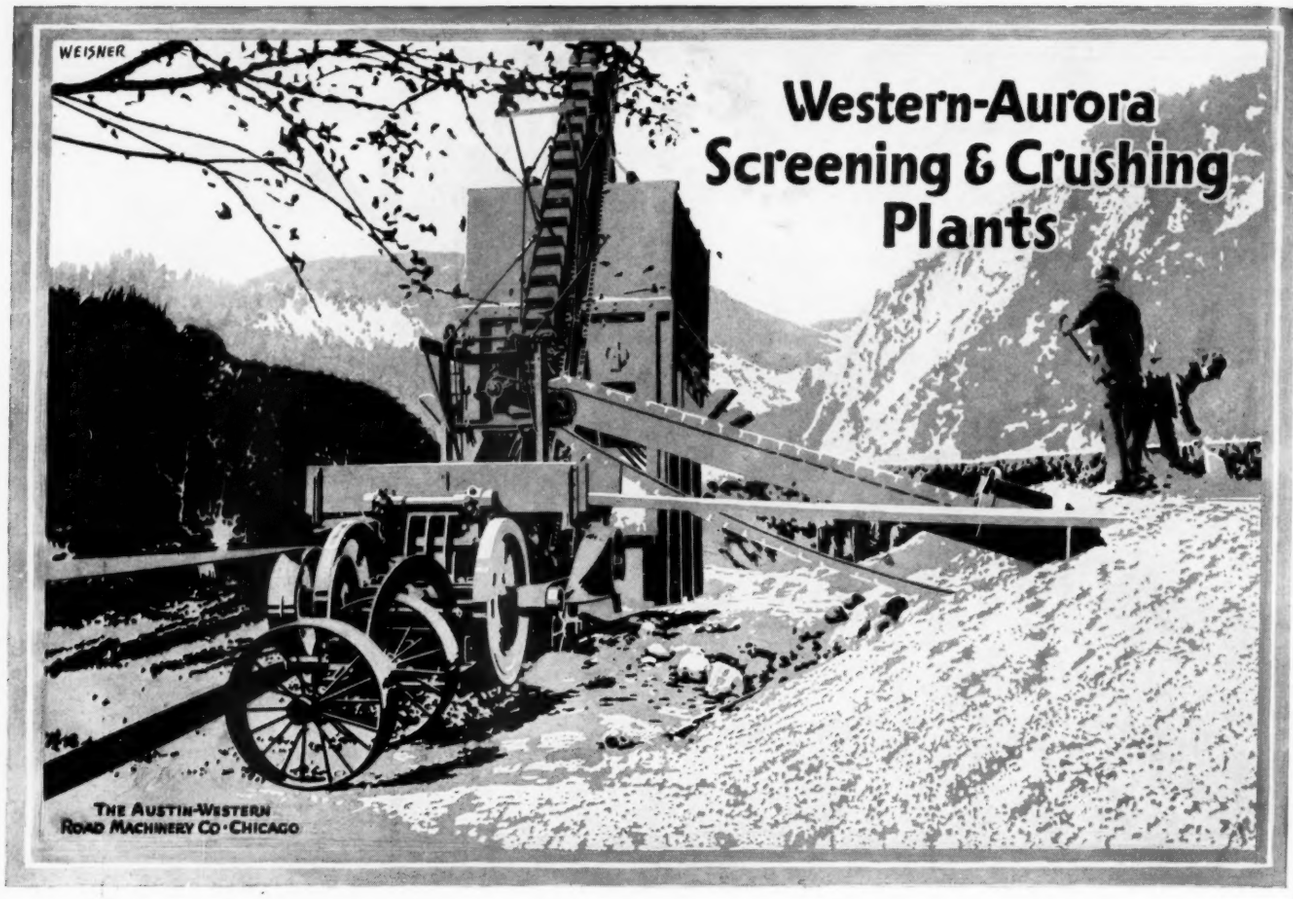
MARCH, 1924



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PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 55 March, 1924 No. 3

Comparative Study of Imhoff Tanks

The most practical, thorough and interesting analysis of Imhoff tank design and operation that has been made public in the United States, we believe, was presented at the latest meeting of the Sanitary Section of the American Society of Civil Engineers, in the form of a paper entitled "Imhoff Tanks—Comparison of Operating Results," by Harrison P. Eddy, consulting engineer of Boston, supplemented by discussions by John V. Lewis, superintendent of Bureau of Sewage Disposal of Schenectady, N. Y.; John R. Downes, supervising engineer of the Plainfield, North Plainfield and Dunellen Joint Sewage Disposal Works; David A. Hartwell, Commissioner of Public Works and City Engineer of Fitchburg, Mass.; and John F. Skinner, deputy city engineer of Rochester, N. Y.

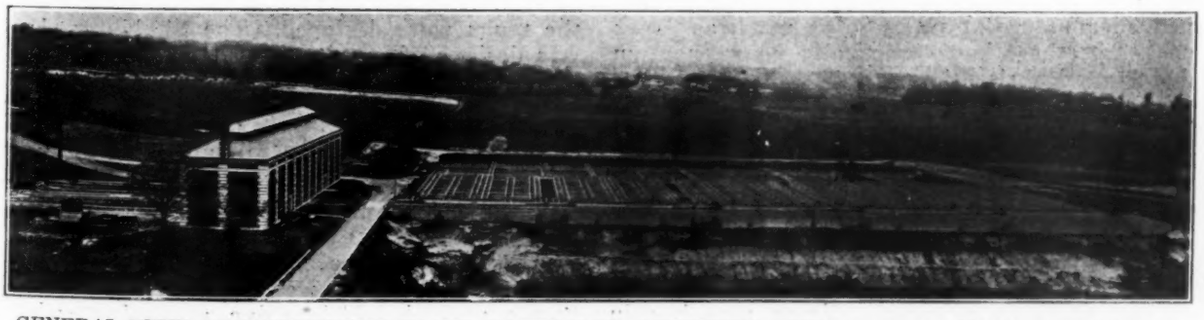
The discussions were by men who are in more or less immediate charge of the four plants compared by Mr. Eddy, and served to furnish additional data and individual interpretations of phenomena, as well as a few greater or less divergences from Mr. Eddy's conclusions.

Mr. Eddy presented in detail a description of each plant, its method of operation, and the results obtained; compared these and suggested in what way differences in construction and operation might account for different results secured by the four plants; and from this study arrived at more or less definite conclusions. The whole is really a treatise on Imhoff tanks, and to present the paper and discussions in full would require a large part of one issue of PUBLIC WORKS. *In the following pages we have endeavored to present an abstract that gives the most important features, combining both paper and discussions. The conclusions of the author are quoted in full.*

The plants selected for comparison in this study were those at Schenectady, N. Y., and Plainfield, N. J., which have given considerable trouble and rather unsatisfactory results; and those at Fitchburg, Mass., and the Irondequoit plant at Rochester, N. Y., which have proved to be among the most satisfactory in the country. All four "have had technical supervision and the differences in results obtained cannot be attributed to lack of skillful operation," and "the operating data are unusually complete and reliable."

THEORY OF OPERATION

Sedimentation Compartment.—The purpose of the upper or sedimentation compartment of an Imhoff tank is to secure sedimentation of suspended solids; that of the lower compartment, to convert these into inoffensive, relatively stable matter. The degree of sedimentation increases with length of detention period in the upper compartment. (But all practical sedimentation is accomplished within 50 to 60 minutes.—Downes.) Prolonged sedimentation, causing removal from the sewage of a larger proportion of the finer



GENERAL VIEW OF IRONDEQUOIT PLANT, ROCHESTER, RECEIVING SEWAGE FROM 250,000 POPULATION. Imhoff tanks at the right, sludge beds beyond them. The power house is operated by the effluent under about 45 feet head.

particles, may affect digestion because these particles are more susceptible to digestion. (This is contrary to Plainfield experience. "The more finely divided solids are more accessible to the disintegrating organisms, but the success of the attack depends upon the composition of the solids in question."—Downes.)

Digestion Compartment.—The digestion compartment has furnished the principal difficulties. This may be divided into the sludge compartment, the scum compartment, and an imaginary "neutral zone" contained between two horizontal planes, one 18 inches above and the other 18 inches below the slot, into which the sludge should not extend from below nor the scum from above. From 30 to 50 per cent., by weight, of solids removed from the sewage escape in solution or as gas, and 70 to 50 per cent. remain as solids in the sludge and scum. (Mr. Downes remarks that in the combined sewage treated at Fitchburg and Rochester, while the mineral street washings represent 25 to 35 per cent. of the suspended solids by weight, they constitute only 1 per cent. by volume of the freshly settled solids.)

Temperature is an important item. If the sludge be maintained just above freezing, very little digestion takes place, but it proceeds rapidly at 70 degrees F. Studies at Worcester indicate that the digestion, as measured by the volume of gases, varies directly as the temperature, from nothing at zero to 200 per cent. of the amount of new matter added when the temperature is 70 degrees; the latter being possible because of the summer digestion of the cold weather accummulation of sludge. As there is very little digestion between late Fall and early Spring, the digestion compartment must be of size sufficient to store the solids deposited during that period, allowance being made for the dilution of sludge, which varies in the different plants from 6 per cent. solids to about 15 per cent.

Gas Formation.—During digestion, gas is evolved which rises into the scum compartment, generally carrying with it more or less of the organic matter in which it is imbedded. Mr. Downes states that in Plainfield the gases are in the form of very minute bubbles which are entrained in solids in such a way that the combined specific gravity is almost exactly one, and the mixture hangs suspended throughout the liquid between the sludge at the bottom and the scum at the top. The amount of solids so suspended amounts at times to as much as 3 per cent. As these have practically no momentum due to vertical rise, they pass into the sedimentation compartment by the interchange of liquids between the two which is continuously taking place.

At some plants much of the gas has produced a light, voluminous foam due to the tenacious films enclosing the gas bubbles, which foam has risen above the walls of the gas vents and overflowed into the sedimentation compartment or to the adjacent masonry. Scum also has in some cases accumulated to such a volume and contained so much gas that it has risen above the tops of the gas vents and extended downward into the neutral zone. When this scum is driven down into the sludge compartment by breaking it up with paddles or streams of water to liberate the gas, the solids rise again in a comparatively short time. This breaking-up of scum involves considerable expense. Mechanical agitators are said to have been used successfully at Newton, Kan., and Enid, Okla.

Biological Action.—Biological action is affected markedly by temperature and probably by other conditions also, although comparatively little is known yet on this point. It is believed that the investigations now being conducted in New Jersey will throw much light upon it. Reaction of the sludge and liquid in the digestion chamber may have considerable effect. Whether excessive acidity that has been found coincident with poor quality of sludge is a cause or a symptom, it is difficult to state. In some cases the use of lime has resulted in marked improvement, but not in others. It is possible that large quantities of carbon dioxide may have a distinct inhibitory effect upon biological activity; which would appear to be of more significance in the scum, where the gases are entrapped, than in the sludge, where they can more readily escape.

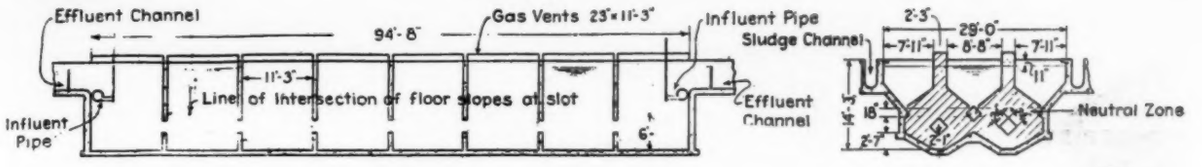
It has frequently been suggested that scum and foam formation may be due to acid fermentation of large quantities of mash from the manufacture of alcoholic beverages in homes and elsewhere. There has been ample evidence recently of the presence in sewage of large quantities of materials used in such manufacture, but whether they are an important factor in the formation of gas and scum has not been proven. It may be that fermentation does not disintegrate the coarser organic substances as do other varieties of action and might cause an abnormal accumulation of scum-forming solids.

DESCRIPTION OF THE PLANTS COMPARED

A description of the four plants will be found in "Municipal Journal" (the name under which PUBLIC WORKS was then published) of the following dates: Schenectady plant, April 15, 1915; Plainfield, November 29, 1919; Fitchburg, September 17, 1914; Rochester, October 26, 1918. A summary of the essential features of these plants and cross sections of the tanks are shown in the accompanying table and diagrams.

Comparisons are made of the four systems of tanks on the basis of populations served and flows treated in 1922 and not on those for which the tanks were designed. The Fitchburg plant was designed for more than double the amount of sewage received in 1922. The Rochester plant, on the other hand, is operating with a load 30 per cent. greater than intended. The tanks vary in length from 64 feet in Plainfield to 110 feet in Rochester. As most of the solids settle near the inlet end, a comparatively short tank may be more advantageous than a long one.

The digestion space at Schenectady is subdivided by partition walls into eight compartments, at Plainfield into five, at Rochester into three, while at Fitchburg there are none.

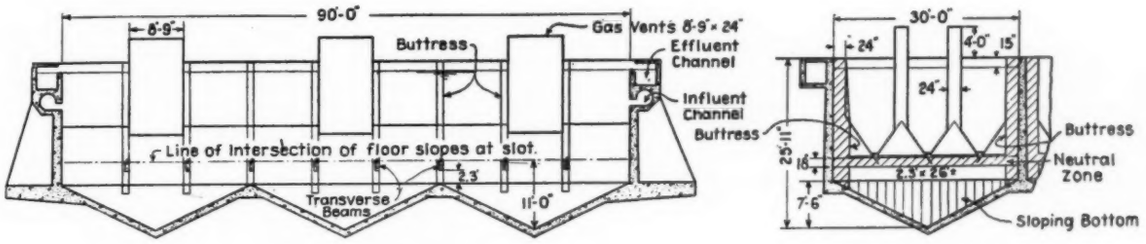


Longitudinal Section — Cross Section

SCHENECTADY, N.Y.

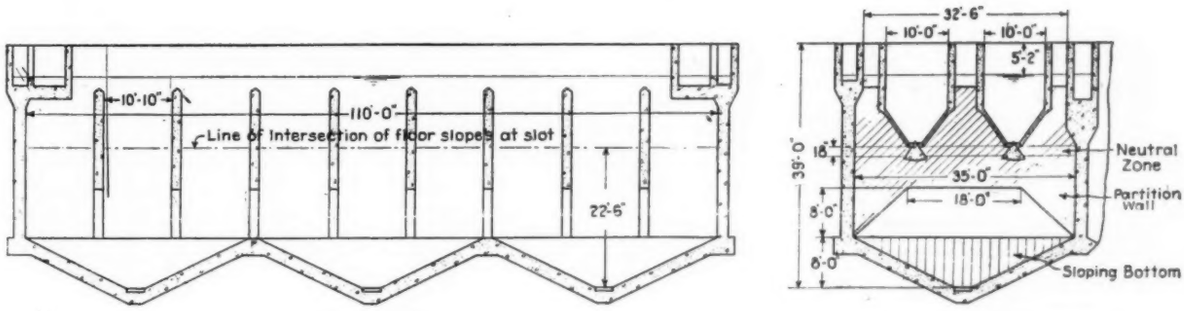
Longitudinal Section — Cross Section

PLAINFIELD, N.J.



Longitudinal Section — Cross Section

FITCHBURG, MASS.



Longitudinal Section — Cross Section

ROCHESTER, N.Y.

COMPARISON OF IMHOFF TANKS IN SCHENECTADY, PLAINFIELD, FITCHBURG AND ROCHESTER.

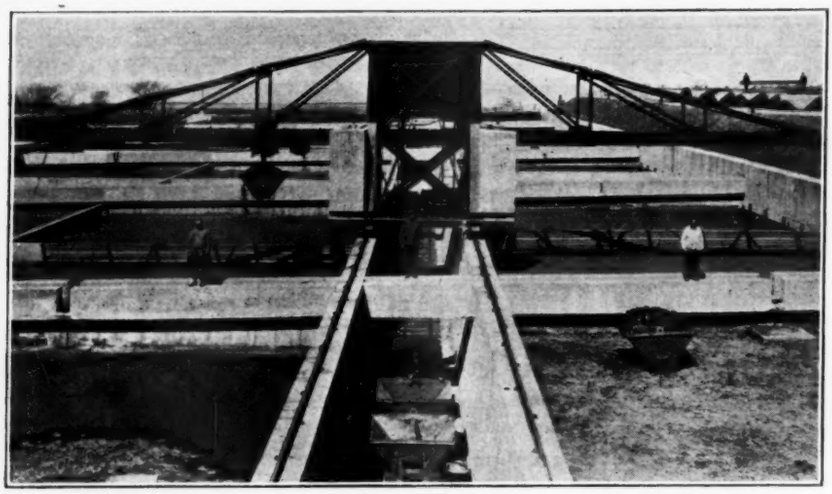
although buttresses subdivide the upper portion of the side scum compartments. As it is important to distribute the sludge throughout the sludge chamber, these partitions are probably undesirable as interfering with this. (Mr. Downes reports Dr. Imhoff as saying that communicating openings between hoppers in the same tank should be closed or at least lowered so as to always be submerged in ripe sludge.) At Schenectady and Plainfield sludge can flow from one hopper to another only through small opening in each partition wall, while at Fitchburg and Rochester distribution of sludge is easy.

Depth of Tank.—The depths of the four tanks below the surface of the sewage, and the distances above and below the neutral zone, are given in the accompanying table.

Vertical Dimensions of Tanks

Plant	Maximum depth below surface of sewage—ft.	Maximum distance below bottom of neutral zone—ft.	Maximum distance above bottom of neutral zone —ft.
Schenectady	13.8	4.6	9.2
Plainfield	19.8	7.25	12.55
Fitchburg	24.7	9.5	15.2
Rochester	33.9	21.0	12.9

These vertical dimensions are believed to be one of the most important structural features affecting the operation of Imhoff tanks, although the reason for this is not entirely clear. One theory is that in the deeper tanks there is a longer path through which the gas-lifted solids must ascend in reaching the scum, which affords opportunity for them to escape and release the solids to settle again to the bottom, thus minimizing accumulation of scum. It is perhaps significant that during the major portion of the year, when the sludge should be considerably below the bottom of the neutral zone, the length



SLUDGE BEDS AT IRONDEQUOIT PLANT, ROCHESTER.

There are four lines of sludge beds, each 44 feet square, served by two depressed tracks. Dried sludge is shoveled into removable car bodies, which are handled by the electric gantry crane. The train of industrial cars is handled by a storage-battery locomotive.

of travel at Fitchburg and Rochester is greater than at Schenectady and Plainfield.

Again, in the deeper tanks the gas is generated under greater pressure and the bubbles therefore expand more when rising, which perhaps aids their escape. With deeper tanks and deeper accumulation of sludge, the density tends to be greater. (Mr. Downes suggests that the greater density of the sludges at Rochester and Fitchburg may be partly or wholly accounted for by the greater length of time the sludge remains in the tank, it seeming probable to him that time has more effect upon this than the weight of overlying sludge.) At Fitchburg and Rochester the maximum possible depth of sludge is twice and four times respectively as great as at Schenectady. It is believed that the relative depths offer a partial explanation of the absence of excessive scum formation and the comparatively greater density of sludge at the Fitchburg and Rochester plants.

Mr. Downes calculates that the differences in the shapes of hoppers at the Fitchburg and

SUMMARY OF ESSENTIAL DATA

Item	Schenectady, N. Y.	Plainfield, N. J.	Fitchburg, Mass.	Rochester, N. Y.
Tributary Population (1922)	65,000	40,000	38,000	260,000
Character of Sewage				
Flow, m. g. d.	6	3.4	3.4	32
Separate or combined sewers	Separate	Separate	Combined	Combined
Strength (suspended solids), p. p. m.	163	166	219	163
Freshness	Fresh uncomminuted	Stale	Fresh	Stale
Industrial wastes	Practically none	Practically none	Small amount	Small amount
Hardness of water supply, p. p. m.	130	88	10	65
Temperature	Av. (1922) 56.1°F; Max. 64.7°F.	46°-70° F.	No data	Av. 54° F.
Preliminary Treatment				
Screening	Coarse rack	Fine screens 1/16" slot	Coarse racks	Fine screens, ⅛" slots
Grit chambers	None	None	Yes	Yes
Imhoff Tanks				
Sedimentation period	3.3 hr.	3.4 hr.	6.4 hr	1.1 hr.
Depth of Tanks				
Total maximum water depth	13' 9"	19' 9"	24' 8"	33' 10"
Sludge Compartment				
Depth below plane of slots	6' 1"	8' 9"	11' 0"	22' 6"
Depth below 18" neutral zone	4' 7"	7' 3"	9' 6"	21' 0"
Distance of lowest point of overflow below 18" neutral zone	2' 6"	2' 0"	2' 0"	13' 0"
Depth below overflow to adjacent compartment	2' 1"	5' 3"	7' 6"	8' 0"
Cubic feet per capita	1.40	1.49	1.88	2.40
Number of hoppers	8	5	3	3
Ease of intercommunication	Poor (2 ft. sq. opening)	Poor (Opening 20" x 24")	Good	Good
Scum Compartment				
Cubic feet per capita	0.76	0.72	1.59	0.55
Area gas vents; % of tank area	14.8	14.3	15	26.8
Area gas vents; sq. ft. per cu. ft. sludge capacity	0.034	0.023	0.031	0.0133
Loading—Deposited Solids				
Lb. per Yr—per cu. ft. sludge and scum space	14.2	10.4	13.1	9.2
Lb. per Yr.—per cu. ft. sludge space	21.9	15.5	24.1	11.3
Lb. per Yr.—per cu. ft. sludge space after deducting 18" neutral zone	30.0	18.9	30.9	12.3
Lb. per Yr.—per cu. ft. scum space	40.4	32.1	28.5	49.7
Lb. per Yr.—per sq. ft. gas vent area	644	674	777	849

Plainfield plants are such that the former concentrates the heavier, older sludge from an area of 900 sq. ft. in approximately the same area filled from 150 sq. ft. in the Plainfield plant; resulting in large gas bubbles. (See above, under "Gas Formation.")

Capacities.—The relative capacities of the sludge compartments, in cubic feet per capita, are shown in the table, together with Dr. Imhoff's recommended allowance.

Relative Capacities of Sludge Compartments.

	Dr. Imhoff's recommended allowance—c. f. c.	Dr. Imhoff's allowance modified because of shallowness of tanks—c. f. c.	Actual gross c. f. c.	Actual net capacities after deducting neutral zone—c. f. c.
Schenectady	1.2	2.4	1.40	1.02
Plainfield	1.2	2.4	1.49	1.22
Fitchburg	1.8	1.8	1.88	1.47
Rochester	1.8	1.8	2.49	2.21

Dr. Imhoff also has pointed out the necessity of providing larger sludge compartments for shallow than for deep tanks. The sludge at Schenectady and Plainfield is only about half as dense as that at Fitchburg and Rochester, and it might therefore be assumed that the capacity of sludge compartments should be twice as great for an equal volume of sewage. Dr. Imhoff also recommends 50 per eent. more capacity for combined sewage than for separate, to allow for the extra quantity of solids and especially for the greater portion of these that are undigestible. This table shows that the sludge capacities provided for at Plainfield are only a little over one-half those recommended. Mr. Eddy also calls attention to the *relative* effect of deducting the neutral zone capacity from that of the entire tank, such deduction reducing the gross capacity about 11 per cent. at Rochester but 27 per cent. at Schenectady.

Mr. Eddy has calculated the loads upon the sludge compartments, expressed in pounds of suspended solids deposited per year per cubic foot of capacity. The first two columns of the accompanying table give capacity up to the slot, the next two columns the net capacity below the neutral area; while the last column shows the relative load, calling that in the Rochester plant one and allowing for the less density of the Schenectady and Plainfield sludge.

"Although these relative loads by volume may be based on a rather uncertain combination of assumptions, they are, nevertheless, significant" and may in part explain the difficulties of operation at Schenectady and Plainfield. "Where the load on the sludge compartment is too great, it is either necessary to draw sludge before it has become thoroughly digested, or to allow it to accumulate and thus encroach upon the neutral zone, or both. In the latter case, the condition is particularly favorable to scum formation."

(To be continued)

Loads on Sludge Compartments.

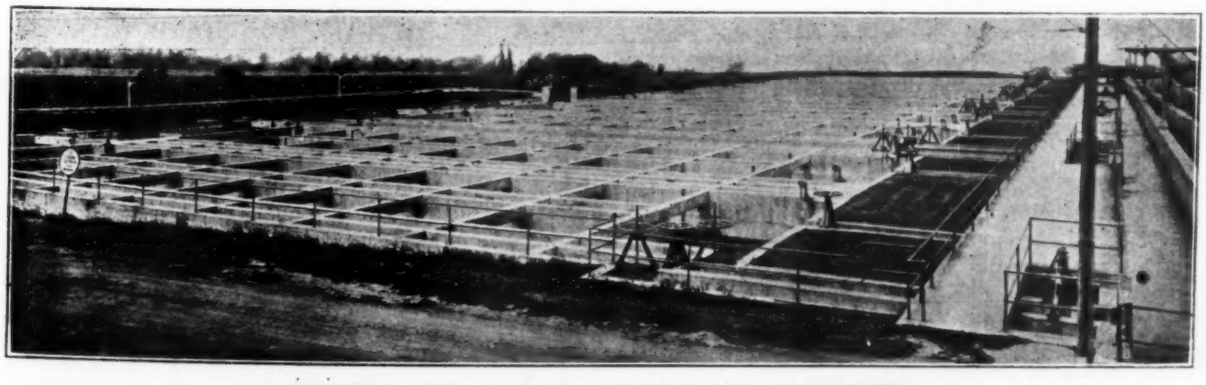
Plant	Suspended Solids based on gross sludge capacity, lbs. per year per cu. ft.	Ratio to load at Rochester	Suspended Solids based on net sludge capacity, lbs. per year per cu. ft.	Ratio to load at Rochester	Relative Load by volume, based on net volume of sludge compartments
Schenectady	21.9	1.94	30.0	2.44	4.6
Plainfield	15.5	1.37	18.9	1.54	2.9
Fitchburg	24.1*	2.13	30.9*	2.51	2.5
Rochester	11.3	1.00	12.3	1.00	1.0

*Includes secondary tank sludge pumped to Imhoff tanks.

Subsoil Investigation

The Bureau of Public Roads has started a very complete and thorough subsoil investigation, the objects of which are outlined by the Bureau as follows:

1. The primary object to be obtained in this investigation is the establishment of fundamental principles which govern the supporting power of subgrade soils, and to correlate laboratory data with field conditions. To estab-



IMHOFF TANKS AT IRONDEQUOIT PLANT, ROCHESTER.
Ten tanks, in five separate units; each tank 35 by 116 feet, with three gas slots. Flow is reversed by operating sluice gates.

lish adequate laws governing the design of subgrades for given loads and climatic conditions.

2. To devise field methods and apparatus which will indicate definitely the strength of the subgrade under the most favorable climatic conditions.

3. To establish the basic relations under field conditions between the physical characteristics of various subgrade soils under varying climatic conditions, and to determine their resultant effects on the supporting value of the subgrade soils.

Tar Macadam in Berwick

By Boyd Trescott

Berwick, with an area now of more than three square miles, is built on a bed of sand and gravel running from a few feet to 80 feet deep. The surface ranges from a fine grade of molding sand to a coarse gravel. Our streets never break up by the action of the frost, due to perfect drainage; but due to the sand and gravel and heavy motor traffic, it became an impossibility to hold the unpaved streets in good order.

Five years ago we began treating with Tarvia, applying the first year about one gallon per yard. This penetrated to a depth of from two to four inches, according to the surface. Later applications were from one-fourth to one-half gallon per yard. This has been continued and several of the streets first treated now resemble sheet asphalt pavements. It makes a solid surface, not slippery, carries all kinds of truck traffic, never breaks up, never is muddy, and there is no movement of the sand and gravel to the gutters to be hauled away. Where small pot holes appear, they are carefully swept out and an application of small gravel and cold patch material is placed in the holes, being careful to maintain the grade of the surrounding surface. Last year we used 76,000 gallons, and we estimate that the saving in up-keep more than pays for the Tarvia and we have the benefit of the good surface the whole year.

Last year we treated about 15,000 yards of brick pavement with Tarvia and coarse sand where the cement grout had worked out. A light coat of Tarvia was applied and the surface thoroughly broomed to remove any surplus, and the street was immediately covered with sand and left open to traffic. The sand was driven into the space between the bricks and the appearance to date is that the treatment was a great success.

Gravel streets are made simply by working the surface to grade, and if the original surface is fine sand an application of coarse gravel is made and then rolled. If the surface is too soft when the grading is completed, very coarse gravel is applied—even up to six-inch stones—and rolled until it is firm, and then a cover of fine gravel is applied, and our troubles are over for that section until it has become thoroughly settled, when Tarvia is applied. The nature of our gravel is such that it is very common to make excavations for sidewalks and cellars, take the materials removed and add cement and put it back for the walk or the cellar wall, in many cases without screening.

Maintaining Nevada's Gravel Roads

The year 1923 was the fourth during which the Nevada State Highway Department maintained any considerable mileage of gravel roads. As we have previously described, such roads in that state are really under construction throughout their first year, in that compacting is done by traffic, the roads being kept surfaced to eliminate ruts. Consequently much of the work classed as "maintenance" is really a part of the construction. Where the type of original surface was entirely inadequate for the rapidly increasing traffic, reconstruction sometimes begins almost before the original construction, as explained above, has been completed.

The Department believes that the maintenance for 1923 furnishes a fair criterion of future maintenance of its highway system. During that year 261 miles of completed highways was maintained, of which 163.8 miles was gravel. The average cost for the year per mile of all highways was $337.33, and the average for the gravel roads was $289.10.

Of the cost of maintenance of gravel roads the items were as follows: Additional surfacing material, $129.56; culverts and ditches, $21.78; cutting weeds, $4.25; dragging and sloping, $36.18; sprinkling, $12.61; removing oversize material, $38.03; repairing washouts, $9.01; guard rail repair, $0.54; miscellaneous, $37.07. The item of additional surfacing could be classed as betterment or partial reconstruction, representing as it does the placing of an added thickness of surfacing material on certain projects, some of these receiving 2 inches and one 4 inches of additional material.

There were 31.46 miles of concrete highways to be maintained and the average cost of maintenance was $515.02. However, $244.84 of this was spent in building and surfacing shoulders. Of the remaining $270.18, $117.30 was filling expansion joints and cracks, $50.45 was cleaning culverts and ditches, $6.22 was cutting weeds, $9.18 was repairing guard rail and $87.03 was miscellaneous.

"Shoulder maintenance on concrete highways becomes expensive until the shoulders are entirely surfaced with either crushed rock or gravel. It is the policy of the Department to properly surface these shoulders just as rapidly as possible, and during the past year this work was carried forward to the extent of 47 per cent of the total cost of maintenance on this class of highways. . . . . When the shoulders are placed in proper condition, the annual maintenance costs will be proportionately reduced and will then become what might be termed current annual costs."

In addition to these two classes of roads, about 7 miles of selected material surfacing, 53 miles of unsurfaced earth and 24 miles of uncompleted projects were maintained. The total expenditure for maintenance during the year was $110,725, all of this expended directly by the state except $8750 which was turned over to the county commissioners.

Collecting City Refuse

Traction physics, collection requirements, and designing of collecting vehicles. Experiences of four municipalities in the use of electric trucks for refuse collection. Time test of collection in Pasadena.

An article on collection of city refuse appeared in a recent issue of "Pacific Municipalities," the official publication of the League of California municipalities, which contains some statements and data that we have not found in other writings on the subject. In presenting the article, the editor of "Pacific Municipalities" explains that the writer of it, Charles E. Mowry, is interested in the sale of storage batteries for electric trucks, but has tried not to be influenced by his commercial interests in collecting and presenting this information. Some of the more interesting features are abstracted below.

Collection costs much more than final disposal; consequently a reduction in cost of collection effects material saving in the cost of total operation of refuse disposal. The cost of collection is affected considerably by the vehicle used. Selection of vehicles is influenced by the weight and bulk of load to be carried and the method of loading and unloading; by operating conditions, including length of haul, grades encountered, speed required, and number of stops per mile; and by cost of operation.

Resistance to motion of a vehicle is due to friction and wind, to resistance of grade and to inertia in starting and stopping. Wind resistance may be neglected for vehicles collecting refuse. The author assumes a gross weight of 6,000 pounds of vehicle and load, and states that experiments with solid-tire trucks on average pavement show that, to move this load a thousand feet on a level at 20 miles an hour requires 150,000 foot-pounds of energy; and to accelerate it from a standstill to 20 miles an hour requires 80,000 foot-pounds. The grade resistance he gives as 60 foot-pounds for each per cent. of grade per foot travelled.

The significance of the second figure—the energy required to bring the vehicle up to a 20-mile speed on a level—lies in the fact that in collecting refuse from houses the vehicle stops every 50 to 100 feet.

The requirements for an ideal transportation unit are given by the author as reliability, simplicity, long life, low cost of operation and maintenance, low fire hazard, speed, and mileage. Without making comparisons with other equipment, he considers the electric truck from these points of view. As to reliability, he states that, having no reciprocating parts and very few rotating ones, it is free from vibration and hence does not get out of order; while the perfect control of speed minimizes danger of wrecking. It is exceedingly simple, consisting of a motor, controller, battery, differential, frame and four wheels. It can be driven and operated by most inexperienced help. The average life of an electric truck is from ten to fifteen years, which is a conservative estimate as there are electric trucks operating today in New York City that have given efficient service for twenty-three years without replacement of major parts.

As to cost of operation and maintenance; as stated above, repairs are seldom necessary and those that are can be made without the employment of a skilled mechanic. A firm in San Francisco operating forty-two electric trucks employs two men to charge, repair and maintain them, exclusive of painting, and these two are by no means overworked. An electric truck is easy on its tires and gets large mileage from them. The electricity consumed constitutes but a small part of the cost of operation. Not using combustible fuels, the inherent fire hazard is very low.

The speed is determined by the designer, and there is no reason why an electric could not be designed to travel at high speed. There is no need of high speed in the short hauls and frequent stops necessary in collection work, the quick getaway of the electric being of far greater advantage here. Also inability to run the vehicle at unnecessary speed keeps down cost of repairs, tires and collision damages. As to mileage, an electric truck will travel 40 to 50 miles on one charge of the battery, while a collection vehicle in city service rarely is called upon to travel over 25 to 50 miles a day.

DESIGN OF COLLECTING VEHICLES

The author assumes that it is desirable that refuse collection vehicles be adapted to handling all types of refuse and that therefore the body should have sufficient volume to contain a full load of bulky rubbish, the weight of which will run perhaps 5 to 15 pounds per cubic foot. It we take 15, this would give 5 cubic yards per ton of rated capacity. As refuse can be heaped up, it is possible to overload the vehicle somewhat over 100 per cent. The average dump body has a volume capacity of from 1 to 2½ yards per ton of rated dead weight capacity. It is evident that a rubbish collection unit must have a specially designed body, and in designing such a body it is recommended that 5 cubic yards per ton of rated capacity be used.

The body should be of iron plate, finished smoothly inside and made watertight and equipped with closely fitting covers. It may be either side or rear-dump type, the latter being generally preferable, although the method of segregation and unloading may influence this. Since the refuse must be loaded into the vehicle by the man standing on the ground, it is desirable that the body be low. As the width and length to which a body may extend is limited, this suggests a drop or underslung frame vehicle, and where the vehicle will always operate on sufficiently smooth streets, it is felt that such a type should be adopted.

Length of Haul. A self-propelled refuse col-

lection vehicle can rarely travel more than 25 miles a day, as the stops consume the greatest part of the time.

Grades. Motor equipment is more flexible than horse equipment in hilly regions. Where the route can be so arranged that the vehicle will always be traveling light uphill and loading downhill, horses are not under so much handicap; but the motor vehicle also can take advantage of the same routing by coasting downhill. Electric trucks operate successfully in very hilly cities such as San Francisco.

Speed. Since the vehicles are to operate in municipalities where speed regulations are in force, there should be no demand for a maximum speed of over 15 miles an hour. In fact, the average speed for the day will be determined by the vehicle's ability to start and stop quickly rather than by its maximum speed.

Stops. A collection unit stops about every hundred feet in ordinary city work, and the writer maintains that for repeated stopping and starting the electric vehicle is the best one available for such service. In fact, he claims that, comparing an electric with a maximum speed of 12 miles an hour with another type of motor truck reaching 20 miles an hour, even though after collection it might be necessary to haul the refuse 12 miles to and from the dump or disposal plant, the 24 minutes' difference in the respective times required by the two vehicles to cover this 12 miles would be compensated for by the saving in quick getaway of the electric after each stop.

EXPERIENCES OF FOUR MUNICIPALITIES

Mr. Mowry quotes replies to a questionnaire submitted by the Electric Storage Battery Company to cities operating electric trucks in municipal refuse collection, these cities being Washington, D. C., Paterson, N. J., New York City, and Pasadena, Cal.

The District of Columbia reported using three electric trucks in the trash collection department, which had been in service practically a year. Two of these are 3-ton trucks with 20-yard bodies and one a 2-ton truck with 16-yard body, no trailers being used. One driver and four helpers operate with each truck. Each truck makes an average of about 300 stops per day and serves approximately 1,500 houses, weekly calls being made in the summer and three times per week in winter. The electric averaged 32 miles per day and the gas trucks 50 miles. Each electric collected an average of approximately three loads per day, taking the rubbish to an incinerator and separating plant. Morris E. Hacker, superintendent of refuse collection of the District, stated: "These trucks were furnished by the truck manufacturers for experimental purposes, and after two months of demonstration and experiment they proved entirely satisfactory and same were purchased. Electrics are, in the opinion of the City Refuse Division, cheaper for certain sections of the city. In the outlying sections, gas trucks are necessary as the hauling is too long for the satisfactory operation of electric trucks."

Figures and information concerning the use of electrics in Paterson are contained in the annual report of the city engineer, a summary of which is published as a separate article. In addition to this information, he stated in reply to the questionnaire that about seven years ago the city started the use of four 9½-ton GV tractors and trailers, the idea of the trailer being to make the body lower and thus more convenient for loading. It was found that with the trailers the tractor used an excess amount of current and was very slow. They increased the number of cells in the battery from 44 to 48, which increased the speed, and by a boost at noon the tractors were able to complete the day's work without difficulty. One of the trucks was remodeled to operate without a trailer and found more satisfactory, as more speed was available for the run to the dump; the current draw of the vehicle was considerably lower and the noon boost unnecessary, which means a longer life for the battery, and it is easier to handle and occupies less room in the garage.

New York reported using three electric 5-ton trucks without trailers in the Washington Heights section, together with sixteen gasoline cars and about ten horse-drawn trucks. A chauffer, two lifters and one shaker accompany each truck. Each truck covers approximately 40 to 50 miles per day with a boost at noon. The cost of operation is $20 to $25 per truck, this being the estimated cost, including the driver's wages, no actual figures being available.

ELECTRIC TRUCK USED BY THE NEW YORK DEPARTMENT OF STREET CLEANING.

Last year a test was made of a truck used by the Pasadena, California, garbage department since September, 1922. The truck was manned with a driver and two helpers. As nearly as possible normal operating conditions were maintained during the test. Two trips were made from the incinerator, one leaving at 4:05 A. M. and returning at 6:21 A. M., the second trip starting at 7:03 A. M., and returning at 10:21 A. M. During the 136 minutes

of the first trip the truck was in motion 48 minutes, and 88 minutes was spent in making 63 stops. Three thousand eight hundred pounds of garbage were collected from the areas of 221 widely scattered houses and 10.9 miles traveled. In the second trip, occupying 201 minutes, the truck was in motion 88 minutes and 113 minutes was spent during 117 stops. The truck traveled 7.3 miles, made 493 collections and collected 5,300 pounds of garbage. The second trip was made through more thickly populated territory.

In conclusion, Mr. Mowry says: "It was hoped, when this study began, that some average figures could be obtained which would assist in approximating the number of trucks required to serve a given city. But it is found that our cities are such a mixture of business blocks, small residences, large residences, apartment houses, rookeries and vacant lots that it is utterly impossible to arrive at any conclusion. It would seem sound practice to arrive at an approximation for any given city by actually trying a truck in the various districts and determining what it can do. About the only suggestion that can be made is that a 3½ or 5-ton unit be employed in congested districts and a 2-ton unit in more scattered residential districts.

"3. Number of operators to the collection unit:

"To get the most out of the investment the collection vehicle must be kept moving. A driver and two helpers seems to be the average solution for the 2-ton units; a driver and four helpers for the larger units.

"4. Employment of personnel:

"The writer thought at one time that a greater economy could be effected by so dispatching trucks as to keep the helpers busy, but observation showed that the helpers were entitled to rest during the run to the dump and back. It is very hard physical work and no real improvement in efficiency could be gained by driving the men.

"5. Employment of material:

"The routes should be laid out with two factors in mind (a) grades and (b) accumulation of load. (a) As previously stated, an effort should be made to have the trucks take up-grades light and down-grades loaded. (b) The trucks should be traveling toward the dumping point as they accumulate their load."

Refuse Collection in Paterson

The annual report on refuse collection and disposal in Paterson, New Jersey, prepared by J. H. Harder, the city engineer, shows as usual that the cost per cubic yard of collecting by electric tractors was less than that by gasoline trucks or by horse-drawn wagons, his figures being as follows:

Collecting 59,438 cubic yards by electric trucks, 45.35 cents per cubic yard; collecting 35,894 cubic yards by gasoline trucks, 61.19 cents a cubic yard; collecting 112,897 cubic yards by horse-drawn wagons, 55.51 cents a cubic yard.

The items going to make up these expenses were: for electric tractors, 35.91 cents for labor, 2.18 cents for current and 7.25 cents for maintenance. For gasoline trucks the costs per cubic yard were: 44.73 cents for labor, 6.29 cents for gasoline and 10.16 cents for maintenance. The horse-drawn wagons were hired and the amount given per cubic yard was the average sum paid the owners for the service. The hire of the horse-drawn wagons naturally included repairs and depreciation, while nothing was included in the cost of electric or gasoline hauling for the item of depreciation. Four electric tractors with a capacity of 10 cubic yards each and three gasoline trucks of 5 and 10 cubic yards respectively were used, and depreciation on those should be added to the total costs. Mr. Harder estimates this at $6,000 for the electrics and $4,000 for the gasoline trucks, adding 10.1 and 11.1 cents respectively. This would leave the electrics and gasoline trucks with the same relative standing as to cost. Some of the current used in charging the batteries of the tractors was obtained from the destructor plant and not charged for, but the value of this probably did not exceed an average of 2 or 3 cents per cubic yard. This would make collection by horse-drawn wagons somewhat less than that by electric trucks, and the latter considerably less than collection by gasoline trucks.

Horse collection was used to a greater extent during the months of November, December, January, February and March than during the remainder of the year, one reason probably being the less demand for horses for farm and other work during the winter period. All four electric tractors were used continuously except during June, July and August. All the gasoline trucks were used during the first six months of the year, while an average of only two were used during the last three. The tractors made an average collection throughout the year of 56 cubic yards per day while the gasoline trucks made an average of 44 cubic yards. The gasoline trucks averaged from six to eight loads per day each, while the electrics made from four to six loads.

Adding to the total cost of operation $6,000 for depreciation on the electrics and $4,000 for depreciation on the gasoline trucks, Mr. Harder calculates that the total cost of collecting and disposing of the ashes, garbage and rubbish of a population of 140,000 was $166,237 for the year 1923. This total includes, in addition to the collection, incinerating 58,316 cubic yards at a cost of 34.84 cents per cubic yard; carting away 7,339 cubic yards of clinker from the destructor at a cost of 70 cents a cubic yard of clinker, or 8.8 cents per cubic yard of material incinerated; and caring for the dumps at a cost of 12.8 cents per cubic yard of material dumped.

Of the cost of incinerating, $15,216 was for wages and $5,103 for maintenance. Of the cost of operating the destructor plant, $20,319, $15,216 was for wages. Of the $5,137 paid for carting clinker, $3,306 was for wages and $1,831 for team hire. Of the $111,590 paid for collection alone, $99,709 was for labor and team hire.

Clean ashes are used for filling low lands and garbage and rubbish are taken to the incinerator. The average haul is about 1½ miles.

Traffic and Traffic Accidents

Suggestions for expediting the movement of traffic on city streets and for reducing accidents to vehicles and pedestrians at street intersections.

In a paper before the 12th Safety Congress, held by the National Safety Council last year, a paper entitled, "Methods of Study of Traffic Movement in Relation to Traffic Accident Prevention" was read by G. G. Kelcey, manager of the Traffic Engineering Division of the American Gas Accumulator Company. This paper contains some excellent suggestions and recommendations concerning the control of traffic with a view not only to expediting it, but also to avoiding accidents to vehicles and pedestrians.

TRAFFIC ROUTES

Mr. Kelcey considered that the first procedure necessary was a study of the traffic movement in the city in question. To do this he recommends using a large city map, which may be hung upon the wall of the office. On this block out areas which are sources of or receive large volumes of traffic. Traffic flows between these areas and into and out of the city. Show clearly on the map where such traffic is congested. Mark the main traffic arteries in some color and the heavily travelled secondary streets with a second color, and with a third color mark desirable routings not at present available but which can be used if improved.

Congestion in most cities is due to inefficient use of part of the street area rather than to the lack of it. Traffic should be routed around the business section because it interferes with the more necessary use of business streets. For example, the City Plan Committee of Buffalo is planning a circuit traffic boulevard around its business area, the cost of which will be great but not so great as that of the conditions which it will correct. This matter is so important that it justifies exhaustive study. One slow truck holds up a long line of vehicles. Routings for slow vehicles should be provided which will be convenient and leave other routes clear for faster vehicles.

As the study develops, it will generally be found that some streets selected for main traffic routes are not in proper condition, while in a few cases short connecting links should be cut through. Such improvements should be given precedence over all other in the paving program of the immediate future.

TRAFFIC CONTROL

Some cities have improved conditions by methods of handling traffic on existing arteries. In Chicago the right-of-way stop plan has been in successful operation, whereby all vehicles using side streets are required to come to a full stop before entering or crossing a boulevard, as a result of which traffic on the boulevard can be maintained at a high average rate of speed—about 30 miles an hour in general in Chicago. Another system is the block system used in Fifth Avenue, New York, by which all north and south traffic is halted at all intersections at the same time to permit east and west traffic to cross, and vice versa. Another plan is that of one-way streets, which are an excellent solution in many districts. One principle essential to this plan is that, for each one-way street, there should be another one-way street a block away carrying traffic in the opposite direction.

Safety zones permit traffic to pass a stopped car, which is not otherwise permitted by the traffic regulations of most cities, and they thus greatly reduce the interference with continuous traffic movement and increase the average speed. Related to this is the skip-stop operation of street cars, and also the plan of collecting fares of entering passengers on the ingoing trip and of departing passengers on the outgoing, thus permitting loading and unloading more quickly in the business part of the city.

TRAFFIC ACCIDENTS

Before endeavoring to reduce the number of traffic accidents, it is necessary to learn the location and causes of them. In most cities it is found that a majority of the accidents occur at comparatively few points. For instance, in one city of 100,000 population, forty-six per cent of all accidents were found to occur at 57 points.

To study this matter, the author recommends the use of accident pin maps. Various colored pins, the colors differing with the nature of the accident, are used and one inserted at each point for each accident that is reported. As clusters of pins begin to develop, it becomes evident where most of the accidents are occurring and generally the cause of them. Any city can maintain such a map at very little expense or trouble, and there is nothing else so important in the study of traffic accidents.

One of the facts determined has been that a major portion of the accidents occur at street intersections, and from 85 to 95 per cent of them occur outside of the congested districts. (Presumably the cause of this is the absence of traffic police here and less care by motorists.)

As a general rule, "make the line of least resistance the right thing to do and most traffic problems can be automatically solved." This can often be accomplished by placing obstructions across wrong courses but not interfering with proper movement of traffic, so signalizing them that it is impossible to fail to see them.

Safety zones are necessary in business or congested areas for the convenience of streetcar passengers and also where it is found that accidents occur due to the lack of them; such places being usually at heavy transfer points. "Traffic discipline" and "safety education" are considered important features in reducing traffic accidents.

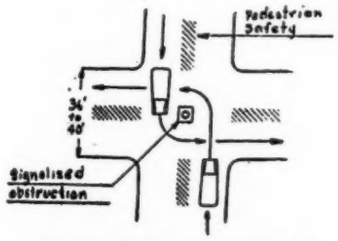
Various investigators have reached the conclusion that the average loss per person in the

United States due to traffic accidents is approximately $15 per year. This represents 6 per cent on $250. Since 100 per cent correction of accident conditions can not be expected, it is suggested that any city is justified in spending $75 per capita in securing a reduction of 30 per cent in traffic accidents.

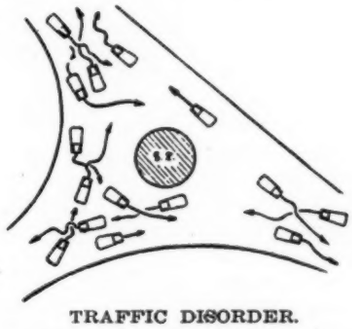
At heavy traffic centers, traffic police are undoubtedly necessary. Men at $1,600 to $2,000 a year, however, are too expensive to maintain at every intersection, and there are many where the traffic can be handled mechanically with practically as good results, while the cost of installing and operating mechanical appliances at danger points is said by the author to be only one-tenth to one-twentieth the cost of men for this purpose. Moreover, the mechanical appliance operates twenty-four hours a day, whereas traffic officers are generally on duty but eight hours and at least fifty per cent of all accidents occur during the other sixteen hours.

The author calls attention to the fact that little can be done with traffic without stepping on the toes of some business man or political group. It is desirable, therefore, to be absolutely certain that any move made can be conveniently defended before the citizens at large. After deciding upon an action, it should be put through vigorously and without favor. In many cities the only way to secure effective results is to organize a group of local business men who will work with the city officials on the traffic problem. This group must be selected so as to merit the confidence of all citizens and must also be composed of men who have punch and power.

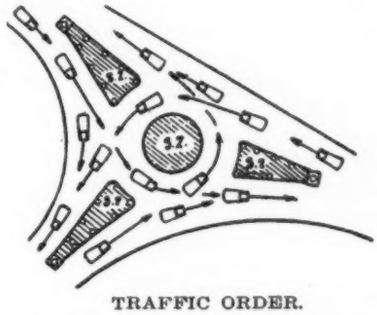
In connection with the paper, Mr. Kelcey presented a number of diagrams or charts showing wrong and right methods of handling traffic at intersections. All of these are based on the fundamental principle that there is vastly more confusion and probability of accident where traffic meets at an acute angle than where it meets at right angles, and that consequently it should be so regulated that traffic lanes all cross at right angles or approximately so. It will facilitate the regulation of traffic if physical obstructions such as curbs, safety aisles, markers, etc., be used to prevent or make difficult the use of traffic paths other than those designated as correct for a given intersection.



CENTER INSTALLATION AT WIDE STREET.
Signalized obstructions must be designed so that traffic cannot disregard or pass over them. They must make the right path easiest to follow and wrong paths difficult.



TRAFFIC DISORDER.
It took four officers to handle this situation. Accidents were frequent and there was much congestion.



TRAFFIC ORDER.
Traffic organized, four men removed 2½ years ago. Accidents and congestion were eliminated. Right paths were made the easiest.

Menasha's Pumping and Lighting Plant

Oil engine plant has operated pumps since 1905, later supplemented with other oil engines, and used for municipal lighting of streets and commercial electric service. Believed to be the first plant of the kind in the world used for municipal service.

By J. H. Kuester *

Menasha, Wisconsin, previous to 1905 (when the city had a population of about 5,000) had no waterworks system, except that about 2,500 feet of 6-inch main had been laid from the canal into the city, to which a 750-g.p.m. fire steamer could be connected and pump water for fighting fire, a number of factories and dwellings being protected in this way.

In 1905 the city voted to issue $75,000 in bonds to be used for building a waterworks system after plans drawn by J. Cadigan and Arthur J. Morgan of Chicago. These plans called for a steam plant of duplicate boilers, pumps and accessories. Among the bids submitted for the pumping plant was one to furnish two 75-h.p. Diesel oil engines made by the American Diesel Oil Engine Company, which guaranteed to pump a thousand gallons of water against a pressure varying from 45 to 60 pounds at a cost for fuel of not to exceed five mills on a basis of paying 3½ cents per gallon for oil of 24-26 Beaume. This bid seemed to the Water-

*Supterintendent, Electric and Water Department of Menasha.

works Committee to be more favorable than any submitted for a steam plant, and was accepted.

ORIGINAL INSTALLATION

The plant installed at this time consisted of two 13x12 triplex, single-acting gear and belt-driven pumps, the contract for which was awarded to the Goulds Company; operated by two 75-h.p. Diesel engines. The engines appeared on the outside to have been very crudely constructed and finished, but they served well for fifteen years before being replaced by others. The change of plans from steam to oil engines permitted reducing the size of the building by about a half.

In the same year, 1905, the contract for lighting the streets expired. The city council found that the engines operating the pumping plant furnished more power than would be needed for some years to come and, therefore, decided to install a 60-k.w. generator and switchboard and operate the generator from the engines by means of an additional pulley placed on the opposite end of the engine shaft. About $10,000 was accordingly spent for the generator and for the poles, wires, arc lamps, etc., and the city, thereafter, was furnished with all-night every-night street-lighting service at a lower cost than they had formerly paid for moonlight schedule service.

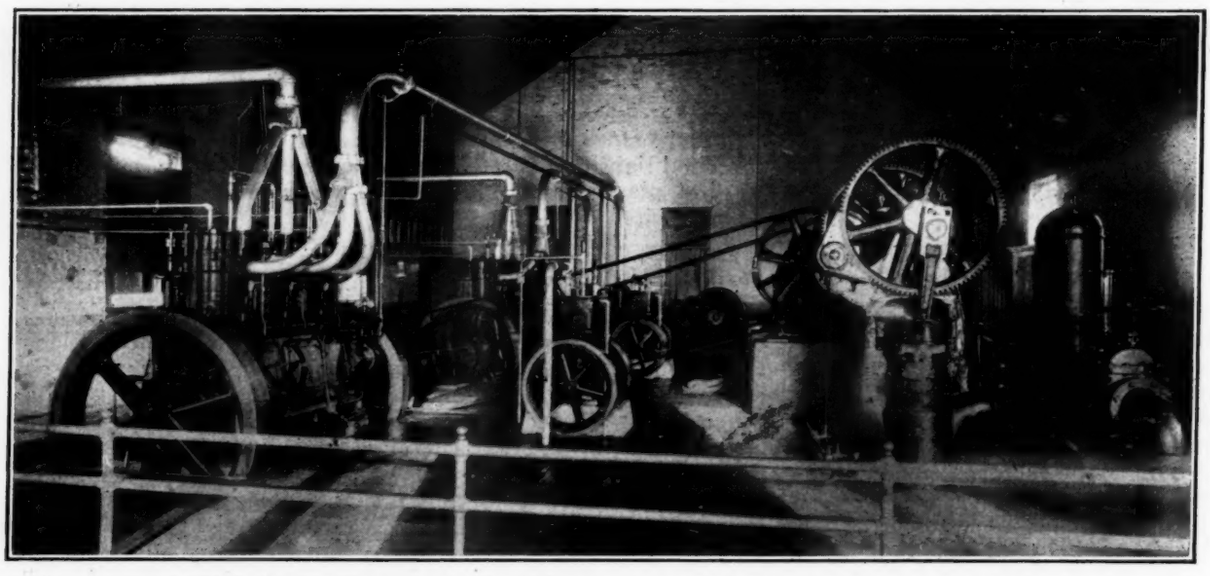
This plant operated satisfactorily and with a very reasonable amount for repairs and maintenance, but in 1911, in order to extend the amount of street lighting and furnish cheaper electric current for the citizens, the city council decided to increase the output of the electric plant. For the new plant a 225-horsepower Diesel oil engine and a 200-kva. belt-driven generator were obtained and the street wiring was extended and rates to citizens made lower than that charged by the electric company, whose plant was five miles distant; the new plant was loaded to capacity in a very short time and in 1913 another plant of the same kind and capacity was installed, with additional panel and switchboard accessories. With each of these lighting units it was necessary to construct an addition to the building. Also, in 1912, a 50-horsepower motor was installed to drive one of the pumps which had formerly been driven by the original 75-h.p. unit that was used to drive the generator, so that this 75-h.p. unit could be used as an auxiliary for the electric plant.

There is some loss in converting the power from generators to the motors driving the pumps, as compared to driving pumps direct from the engines, but we believe that this is warranted by the more flexible operation obtained for all purposes and the simpler apportioning of costs in a combined plant.

These two 225-h.p. and one 75-h.p. engines generated all the current used until 1917, when the increasing load necessitated further additions. Prices were asked on a 500-h.p. unit, but as this year was nearly at the peak of war prices, the council decided to purchase the additional current needed. This arrangement is still being continued, but we are seriously considering installing a 600-h.p. or larger unit to carry the load that is now being purchased, together with the increase anticipated for the next few years.

In 1919 a 2,000-g.p.m. centrifugal, motor-driven pump was installed to take care of the large industrial demands that were arising and to maintain the fire-fighting pressure, and in 1920 another 50-horsepower motor was installed to drive the other triplex pump.

It was decided at this time to abandon the two original 75-h.p. Diesels, which had then been operating for fifteen years, since it seemed to be more economical to purchase new engines than to spend the amount that would apparently be required to maintain these. During these years the city has never been deprived of water pressure due to any failure of the engines. We believe that these were the first Diesel engins in the world to pump water and generate current



ORIGINAL PUMPING INSTALLATION OF THE MENASHA WATERWORKS PLANT.

for municipal purposes. These old engines are soon to be removed and replaced with new Diesel engines.

No precise records were kept during the first few years to show the cost of maintaining these original engines, but the annual cost of maintenance was, perhaps, 3% of the original cost; this estimate being based on the cost of maintaining the 225-h.p. units during the past twelve years, which has been considerably less than 3%. These large units ought to serve us for at least another twenty years unless the service required should exceed their capacity, in which event they ought to bring a good salvage price from someone who could use units of this size. There has been an improvement in the manufacture of this type of engine, and those now being built by the older companies can, I believe, be maintained for 2% or less of their cost, depending on the care they receive and the work they do, and ought to have a minimum life of twenty-five years if they are selected wisely as to present and future growth of the service they are to render.

We have a fuel oil shortage of 50,000 gallons in two 10,000-gallon tanks and one 30,000-gallon, which are filled from a siding 1,100 feet away through a line of 3-inch bell-and-spigot pipe. The fuel cost for generating current can be expressed approximately by the rule that for each cent of cost of oil per gallon, one k.w.h. at the switchboard will cost one mill. This cost obtains providing the engines are kept in good economical running order.

Menasha has the lowest water rates of any city in the State outside of Milwaukee, these being 15 cents per thousand gallons maximum down to 2½ cents per thousand gallons charged to only the largest industrial users. The light and power rates are saving our consumers about 30% as compared to rates charged by electric companies in nearby cities, while the lighting of the streets is very much better than our sister city obtains for an equal outlay. Our combined water pumping and electric consumption gives us a load factor better than 50%, including that purchased from the electric company, which is based on a demand charge; which is one reason for our ability to give low rates and for our financial success. For several years the plant has made a return on actual investment quite a little larger than is usually allowed for depreciation, taxes and all other fixed charges.

At present our water system includes 20,000 feet of cast-iron watermains of 4 to 20 inches diameter, 135 fire hydrants and about 1,260 water services in use, practically 100% metered. Water is taken from the Fox river near the mouth of Lake Winnebago, is chlorinated but not filtered, and is pumped to an elevated standpipe of 86,000 gallons capacity. The electric current operates 216 street lamps of from 250 to 600-candlepower and 350 40-watt lamps suspended on twelve arches over Main Street, and in addition serves consumers through 1,875 electric meters. The plant is operated with a chief engineer and two assistant engineers on 8-hour shifts, with extra help furnished for repair and maintenance jobs.

At present the city has a population of 8,500 and contains several large industries and a number of smaller ones, including some fair-sized paper mills.

Water Control in New Jersey

Governor Sulzer of New Jersey has urged the Legislature, in a special message, to take immediate steps to secure absolute control of all sources of water now being used by the communities of the state and also such additional supplies as may be needed in the future. He stated that he is not committed to any particular plan but believed that municipalities should submit to the consolidating of existing systems and that property of privately owned water companies should be taken over by the state without having to pay an unjust tribute to them in making the purchase. He suggested that the state, having obtained control of all water supplies, should sell the water to the cities at wholesale while the latter would distribute it to their respective inhabitants.

Such a plan, if carried out, would permit distribution of the available supplies to the several communities in proportion to their needs and reduce interest charges on bonds in case of supplies now municipally owned, and the elimination of profit in the case of those privately owned. Bonds could be sold by the state to meet the costs of purchase and development and could be paid off by the income from the water sold to the municipalities.

Sewer Repairing in Dayton

Old brick sewers in unsafe condition repaired by lining invert with vitrified brick and reinforcing arch with gunite, with or without steel reinforcement.

By Ivan E. Houk*

During the years 1920 and 1921 the city of Dayton, Ohio, found it necessary to make extensive storm sewer repairs. Some of the older sewers, which had been in service twenty years or more, were found to be in such condition as to require immediate attention. Some sections seemed to be practically on the verge of collapse. In a few instances as many as five or six rows of brick had fallen out of the inner courses of the arch crowns for considerable lengths. In other cases, where sand and gravel could be washed into the sewers during heavy rains, the inverts had been worn nearly through by the scouring action of the material carried along the bottom.

The repairs were made primarily by the aid of a cement gun, which had been purchased for

*U. S. Reclamation Bureau, Formerly City Engineer of Dayton, Ohio.

that purpose at a cost of $5,680. However, in one instance vitrified liners were placed in the invert and the cement gun used only to build up smooth connections between the edges of the liners and the sides of the sewer. With the exception of one large stone-arch drain about 25 feet wide and 12 feet high, the sewers repaired were circular in section, with diameters varying from 4.5 to 9 feet. In some cases they had originally been built of brick masonry; in others, of plain or reinforced monolithic concrete.

The sewers in the worst condition, as for instance those with the dilapidated arch crowns, were repaired by constructing new reinforced arch rings inside the old. Others were repaired by patching with gunite, or by installing liners as mentioned above. Still others required only a small amount of pointing up where the original mortar had become loose or had fallen out. Of course the loose mortar or masonry was removed in all cases, and the surfaces thoroughly cleaned before applying the gunite. The following tabulation gives some pertinent data concerning the larger sewers repaired, and the nature of the repairs:

DATA REGARDING REPAIRS OF LARGER SEWERS

Sewer	Diam. feet	Const.	Length feet	Nature of Repairs
Apple Street	25*	Stone	200	Pointed up with gunite
Apple Street and Seely Ditch	8	Brick	325	New reinforced arch ring.
Indianola Avenue .	6	Concrete	716	Arch repaired with gunite.
Park Street	7	Brick	3,000	Invert repaired with gunite.
Caldwell Street ..	9	Rein. Conc.	1,200	Invert repaired with vitrified liners and gunite.
Eastside Drain ...	5.5	Brick	1,384	New reinforced arch ring.

* Arched section about 25 feet wide and 12 feet high.

The gunite consisted of a 1 to 2 mixture of cement and sand. It was applied in thin layers over a section forty or fifty feet long, until the total thickness amounted to from 2 to 3 inches. By working over such a large area at a time the cement in one layer had time to partially set up before the next layer was applied, and consequently did not drop off the arch crown in chunks as it did when the operations were confined to a smaller area. A pressure of about 60 pounds per square inch was maintained at the nozzle.

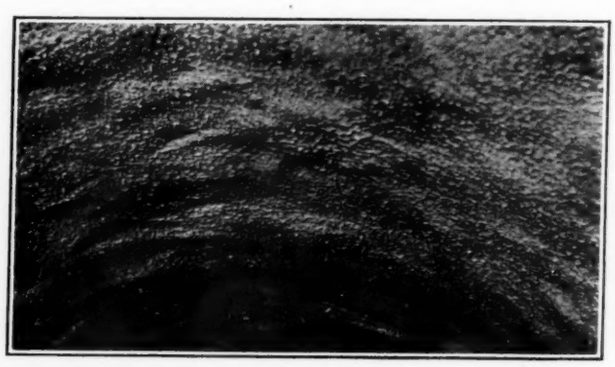
The cement gun and air compressor were operated on the streets in all cases, only the hose and nozzle being carried into the sewer. A length of hose sufficient to reach from one manhole to the next, if necessary, was kept on hand at all times. The work gang consisted of a foreman, who directed the operations; a cement gun operator, who handled the nozzle; and four helpers, who mixed the cement and sand, placed the reinforcing, and did such other work as was required. The foreman was paid $10 a day, the cement gun operator $7.50, and the helpers, $5 each.

SUMMARY OF SEWER REPAIRS AND COST

Extent of Repairs	1920	1921	Both Years
Total length of larger sewers repaired—feet	5,241	1,384	6,525
Area repaired by gunite, sq. yds.	6,081		6,081
Area repaired by rein. gunite, sq. yds.	364	1,330	1,694
Area repaired by vitrified liners, sq. yds.	336	none	336
Total area repaired, sq. yds....	6,781	1,330	8,111
Cost of Repairs			
Cement gun parts and repairs.	128.73	19.30	148.03
Labor	$9,128.28	$2,040.14	$11,168.42
Sand	136.13	34.00	170.13
Cement	3,699.34	1,059.11	4,758.45
Wire mesh reinforcing.....	49.00	196.88	245.88
Steel bar reinforcing.....	49.42	197.68	247.10
Oils and lubricants.....	297.96	112.26	410.22
Hose for cement gun.....	338.00	none	338.00
Miscl., including liners, engineering, contingencies, and so forth	750.00	100.00*	850.00
Total cost of sewer repairs.....	$14,576.86	$3,759.37	$18,336.23
Cost per lineal ft. of larger sewers	2.78	2.72	2.77
Cost per sq. yd. of area repaired..	2.15	2.83	2.26

*Estimated.

INTERIOR OF ARCH OF SEWER READY FOR REPAIRS.



ARCH OF SEWER AFTER REPAIRS WITH GUNITE.

The accompanying photographs show one of the worst sections of one of the larger sewers after it had been cleaned and the reinforcement placed, and again after it had been covered with gunite. The reinforcement consisted of ½-inch round rods, placed 18 inches apart, together with 5-inch wire mesh. The rods were placed first, then the mesh, the latter being fastened in place by wiring to the rods. Only the upper halves of the sewers were reinforced; but the gunite was carried into the lower halves until smooth connections were built up between the new rings and the old.

The work was begun during the first week of May, 1920, and was completed about the end of February, 1921. Fairly satisfactory cost data was compiled for the total amount of the repairs made during each calendar year; but not for each separate job. However, since one fairly large job, the Eastside Drain, was started about the

first of January, 1921, the data for that year are particularly valuable. The detailed cost data for each year, and also for both, together with a summary of the repairs made, are given in the above tabulations, corrections having been made where materials were purchased in 1920 and used in 1921. The expenditures for cement gun parts and repairs necessary during the progress of the work, and also the cost of extra hose, are included as a part of the cost. However, the first cost of the gun is not included.

This tabulation shows that the average cost of the repairs amounted to $2.83 a square yard for the reinforced work, and to $2.26 a square yard for all the repairs made, prices which are very small when compared with the cost of building new sewers of equal size. These prices could be lowered somewhat at the present time due to the reduction in labor and material costs which have occurred since the work was done. It will be noticed that the expenditures for labor and cement constituted the principal items of cost.

How long the repairs will last, of course, remains to be seen. The writer made a careful inspection of some of the work after it had been in service about two years. At that time no wear or disintegration could be observed in the upper parts of the cross section, and only very slight wear in the inverts. Inasmuch as this was the first work of such nature to be done by the city, Dayton's experience does not as yet furnish any conclusive evidence regarding the life of such repairs. However, there is no doubt in the writer's mind but that the work has lengthened the life of the sewers more than enough to justify the cost. The writer is also satisfied that the method adopted was the proper one under the circumstances. Any other adequate method of repair, or the construction of new sewers would have been much more costly. Moreover, other methods would have involved excavating from the street surface and the accompanying interference with traffic.

No measurements were made to determine the effect of the work on the discharge capacities of the sewers; but it is believed that the effect was beneficial in all instances; or, at least, not detrimental. The sewers after repairing were certainly smoother than before. It is believed that this increased smoothness in every case compensated, or more than compensated, for the obstructions to flow caused by filling in parts of the cross section with gunite. The Eastside Drain, a 5.5-foot circular brick sewer, which was repaired by constructing a new reinforced gunite arch ring inside the old, may be discussed as an extreme case. The roughness factor n in the Kutter formula must have been about 0.017 for this section before the repairs were made. If the application of gunite reduced n to 0.015 the capacity of the sewer would be the same after repairing as before. This is assuming the new ring to extend halfway around the perimeter and to average 3 inches in thickness, the latter assumption being on the conservative side. Of course, the proportional part of the total area taken up by a 3-inch ring is smaller for the larger sewers. It is also apparent that the proportional part of the flow area filled with gunite was negligible in the case of the sewers repaired by pointing.

The work was done by force account, under the direction of the Division of Enginering. George F. Baker, now Director of Public Service, was City Engineer at the time the work was done. F. O. Eichelberger, present City Manager, was Director of Public Service.

Ground and Surface Waters

The latest report of the Department of Public Health of Massachusetts contains analyses of the public water supplies of the state, made during the previous year. These analyses give the color, residue on evaporation, ammonia (free and albuminoid), chlorine and hardness of 171 surface waters; and the same plus nitrogen (as nitrites and nitrates) and iron of 117 ground water supplies. It was thought that a partial comparison of these might be interesting, and such is given below.

In color the surface waters averaged 0.23 parts per 100,000, the ground waters 0.058, or about one-fourth. The maximum for any surface water was 1.85 for one of the supplies of Athol. The maximum for any ground water was 0.52 for Amesbury tubular wells. Four of the surface waters had a color of 0.00, and 71 of the ground waters.

In residue the surface waters averaged 4.78 parts and the ground waters 7.38. The maximum for any surface water was 12.00 for Lenox, and the maximum for a ground water was 39.80 for Provincetown. The minimum for surface waters was 2.17 for Hinsdale, and the minimum for ground waters 2.97 for Northbridge.

In hardness the surface waters averaged 2.04 parts and the ground waters 3.00. The maximum for any surface water was 11.1 for Lenox, and the maximum for ground waters was 13.6 for Adams.

Iron was presumably present in too small quantities in the surface water to take account of. In the ground waters iron was found in every case, averaging 0.036 parts, with a maximum of 0.693.

Seven of the ground water supplies were from filter galleries, seven from springs, and the remainder from wells.

Colors for Traffic Signals

The American Engineering Standards Committee is endeavoring to secure national uniformity of traffic signals. At present, for instance, green is used in Chicago for "Stop," whereas on railroads it means "Go Ahead." Among the points to be considered in selecting colors is significance of the color, visibility, and relative contrast.

Three working committees have collected and digested information pertaining to visibility of colors and have reached the conclusion that railroads are correct in confining the colors used to three—red, green and yellow. The committee also is agreed

that all the highway signals for automobilists should employ the same color scheme, instead of using black, white, red, yellow, blue, green, brown, etc., indiscriminately as at present. It also recommends that signs intended for pedestrians should employ a different color scheme from that intended for motorists.

The committee to formulate the code for standard colors is headed by Charles J. Bennett, formerly state highway commissioner of Connecticut. Thirty-three different organizations and governmental bureaus are represented on the committee. A subcommittee is studying questions relating to visibility and is headed by Dr. O. A. Gage of the Corning Glass Works.

Snow Removal from Wisconsin Highways

The methods and costs of snow removal from highways by several of the counties of Wisconsin are described by M. M. Isabelle, assistant maintenance engineer of the Wisconsin Highway Commission, in the January issue of the Highways Magazine.

The cost of snow removal in the different counties varies because:

"1. Snow fall is not uniform in all counties.

"2. It will drift in some localities and not in others.

"3. In some cases considerable hand labor is required, thus bringing up the cost of removal.

"4. In some counties the snow is moved entirely off the highway from shouder to shoulder and in others just a single track is cleared with occasional turnouts.

"5. The type of equipment used in counties up to the present time has varied considerably. This is evidenced by the fact that many of the counties were using entirely different equipment at the close of the season than they started with in the beginning.

"6. In some seasons the snow fall comes at intervals covering the entire period with no great snow fall at any one time and again we experience a season when the bulk of the snow fall comes during one or two heavy storms which completely paralyze all traffic.

"7. In many localities local aid is given and this is not always figured in the cost."

Mr. Isabelle gives cost figures for four counties, which carried on systematic snow removal programs for handling the storm of December 14, 1922, which was not followed by drifting. The figures include operating expense only—nothing for depreciation or overhead.

Milwaukee County removed the snow for the entire width of pavement, the others only cleared a traveled way.

The number of miles kept clear during the entire season and average cost per mile were: Kenosha Co., 18 miles, $280; Ozaukee, 18 miles, $140; Racine, 44 miles, $160; Milwaukee, 80 miles, $200.

Highway Cable Railing Tests Filmed

Tests of cable railings recently conducted near Harrisburg, Penn., by attaches of the State Highway Department and the Federal Bureau of Roads were filmed by the latter Bureau. Of particular interest to engineers is the slow-motion film.

In these tests heavily loaded trucks were crashed against sections of the Department's standard guard railings, in which two strands of three-quarter-inch cable are used. Despite the impact, this railing was found highly satistactory and will be used by the Department in all except very dangerous locations.

Zoning in the United States

According to information obtained by the Division of Building and Housing of the Department of Commerce, zoning ordinances were adopted during the year 1923 by eighty-one municipalities with a population of 8,000,000, and such ordinances were in effect in 221 municipalities in the United States on January 1st of this year.

The Department has published a list of the cities having zoning laws, with details as to the date and character of the ordinances. This shows that zoning has been adopted in twenty-four municipalities in California, one in Colorado, one in the District of Columbia, one in Florida, one in Georgia, twenty-five in Illinois, five in Indiana, three in Kansas, one in Maryland, fifteen in Massachusetts, four in Michigan, one in Minnesota, four in Missouri, one in Nebraska, sixty-two in New Jersey, thirty-five in New York, one in North Carolina, fifteen in Ohio, one in Oklahoma, one in Pennsylvania, three in Rhode Island, one in Tennessee, one in Texas, one in Utah, two in Virginia, two in Washington, and eleven in Wisconsin.

Nine other states have adopted laws permitting the adoption of zoning ordinances, by municipal corporations in some cases, in others by municipalities of certain classes, while in other states special laws have been passed for individual cities.

Cost of Snow Removal in Four Wisconsin Counties.

County	Type of Equipment	Number in Use	Miles Cleared	Total Expended	Cost Per Mile	Per Mile per inch depth
Kenosha	Single blade plow on truck	1 with 2 men	15 (7 in. snow)	$24.00	$1.60	$0.23
Milwaukee	Single blade plow on truck	8 with 24 men	80 (4 in. snow)	795.00	9.94	2.49
Racine	Single blade plow on truck	3 with 6 men	44 (8 in. snow)	92.98	2.11	.26
Waukesha	Single blade plow on truck	2 with 4 men	32 (5 in. snow)	197.60	6.18	1.24

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A. PRESCOTT FOLWELL, Editor

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Standard Sewer Pipe Sizes

The committee of the American Society for Testing Materials having to do with clay and cement sewer pipe and known as Committee C-4, at a meeting on March 5th voted that it deemed it advisable to discontinue the use of 20-inch and 22-inch sewer pipe and to substitute therefor 21-inch sewer pipe, and asks the approval of this by other societies and engineers generally. We understand that this leaves for selection 18-inch pipe as the next smaller size and 24-inch as the next larger. As this will enable the manufacturers to do away with one set of presses, one size of pipe to be kept in stock, etc., while there is a difference in capacity between 20-inch and 21-inch sewer pipe of only 10%, which is less than the possible error in estimating either quantity to be carried or capacity of sewer, we do not suppose there will be any objection on the part of engineers to this action; while it should be welcomed by manufacturers, who will, we hope, pass on a part, at least, of the advantage to consumers in the form of somewhat lower prices for the 21-inch sewer than the average of the prices formerly paid for 20-inch and 22-inch.

Preferred Numbers

The matter of intervals between corresponding dimensions of different standard sizes of a given article is one that has been engaging the attention of engineers for years, one of the latest developments having been that of "preferred numbers" which has been imported from Germany. The general idea of "preferred numbers" is that of selecting a series of numbers that differ from each other by a constant ratio rather than a constant or varying arithmetical difference, and using this same series in connection with all objects which are manufactured in an extensive range of dimensions. This would apply to sewer and water pipes; the thickness of steel plates, wires, etc.; the values of pieces of money; everything, in fact. As an illustration of money gradation, we find United States coins and bills of the denomination of one cent, two cents, five cents, ten cents, twenty-five cents, fifty cents and one dollar. The ratio here is by no means uniform, but the intervals between values increase gradually as the values themselves increase. In the case of water pipes, we have the sizes 1 inch, 1½ inch, 2 inches, 2½ inches, 3 inches, 4 inches, 6 inches and 8 inches. If we calculate a series of preferred numbers with a constant ratio of 4/3, and take the nearest quarter inch, beginning with a 1-inch pipe we would have a series 1 in., 1¼ in., 1¾ in., 2¼ in., 3 in., 4¼ in., 5½ in., 7½ in., etc.

If a series of preferred numbers were once generally accepted, it would greatly simplify bringing about an agreement, among manufacturers of all kinds of materials, upon standard sizes and dimensions for their products. There is a question whether a single series could be found that would be most suitable for all the various materials subject to standardization; but the subject is an interesting one and is receiving some attention from engineers.

Workmen's Compensation

According to a recent statement of the Chamber of Commerce of the United States, forty-two states of the Union have already enacted workmen's compensation legislation, thirty-eight of which provide that insurance in some form must be carried. In thirty-five states the employer may insure his workmen's compensation risk with a private company or, if he is able to meet certain standards of solvency, may self insure. Nine of these states have created competitive state compensation funds with which the employer may place his insurance if he de-

sires. Seven have monopolistic state funds with which the employer must insure his compensation risk, except that in two of them he may be permitted to self-insure. In Ohio, which has monopolistic state insurance, thirty-six percent of the risks are self insurers. In the nine states that permit either state or private insurance, the state-operated insurance agencies carry less than fifteen percent of the insurance, while more than eighty-five percent is handled by private companies.

Sidewalk Location in Circleville, Ohio

On Page 40 of the February issue of "Public Works" was given some very interesting information concerning the practice in Circleville, Ohio, with respect to the location of sidewalk pavements, illustrated by photographs showing two types of locations. Through an oversight we failed to give the name of the city engineer who kindly furnished this information and the photographs from which the illustration was prepared. Credit for these should be given to Thomas M. Moore, the city engineer of Circleville.

Removing St. Louis' Garbage

The city of St. Louis about the end of February entered into a new contract for the removal of such of its garbage as is not handled by the incinerator, at much more favorable terms than had prevailed heretofore, or for $1.03 a ton as compared to the $2.10 under the previous contract. For this great reduction in cost the St. Louis Bureau of Municipal Research is apparently most to be thanked and congratulated. Early in February a contract was awarded for disposing of this excess garbage at $1.95 a ton, but, following a protest by a representative of the Bureau, the Board of Public Service rescinded the award on the ground that the form of contract was illegal, and prepared new specifications providing for the removal of about 25 tons per day to hog-feeders in St. Louis County. There was considerable competition under this contract with the result as stated above: the contract of $1.03 per ton being given to the Jefferson Distribution Company, which will take the garbage about 40 miles down the river to a piggery on an island.

North Carolina's Road Show

One of the most unique road shows yet held will be given by the North Carolina State Highway Commission during the first week in June, when a large gathering of roadbuilders will be shown the actual operation of building roads in that state. The show will be under the auspices of the American Roadbuilders Association, with which the State Highway Commission will cooperate.

Construction projects will be chosen located as nearly as possible in the center of the state and illustrating the different types of construction. Equipment manufacturers will place on each of these jobs the most modern equipment designed for the construction of that particular type of road. For example, on a concrete project the latest types of forms, mixers, industrial railway, finishing machines and other items will be used. An expert in the construction of each type of road will be on the job to explain in detail the various steps.

Among the visitors will be a party of from fifty to seventy-five representatives from South American countries who are coming to the United States to study road conditions. The visitors will probably travel over a large part of the state, making their headquarters in the three cities of Greensboro, High Point and Winston-Salem, which cities are centrally located and connected by paved roads, thus giving the advantage of the hotels in all three cities. During the show and as one of its features, there will be held one of the largest road lettings in the history of the Commission. This will also enable the contractors attending the letting to study modern road construction.

Oiling Earth Roads

In a paper on this subject before the Oklahoma Municipal League, Fred Padgett, of the University of Oklahoma, stated that this should not be regarded as a method of hard surfacing, but rather one of maintenance of earth and gravel roads. After describing how to apply the oil, he discussed unsatisfactoriness of results as follows:

"The investigation of oiled roads in various parts of the country reveals that the results secured are subject to considerable lack of uniformity, and consequently to differences of opinion in regard to the feasibility and desirability of the method. Failures in oiling roads can be attributed to a number of causes, but the following are the most important: First, expectation of securing a road equivalent to asphalt or bituminous macadam at a cost less than the interest on the investment for a hard surfaced road; second, ineffective drainage and preparation of the road before oiling; third, application of the oil at the wrong time; fourth, use of an oil of unsuitable quality; fifth, failure to maintain the road after oiling or neglect to apply new oil when necessary; sixth, traffic too heavy; and seventh, soil unsuitable.

"One of the most important factors contributing to the failures in oiling roads, is that of applying the oil at a time when the road is not properly worked or when it is too wet or too dusty. The reason for this is of interest. The shipments of oil are placed on sidings where the product generally is transferred directly to the distributor and then placed on the road. Since demurrage soon begins to accumulate against the shipment unless the car is emptied, the tendency is to transfer the oil to the road whether or not it is in proper condition to receive the oil. This difficulty could be eliminated by making some provision for emergency storage to be used if necessary.

"The choice of oil of proper quality is another important consideration. . . There is often a tendency to make use of an oil which is heavier or more viscous than necessary, resulting in insufficient penetration into the soil and the ultimate formation of an asphaltic mat which does not readily lend itself to maintenance and which tends to break at the edges.

"The writer's idea of the best oil for surface application to earth roads, is one which combines the highest 'asphalt content' with the lowest viscocity, within limits. In Oklahoma, however, a more viscous oil could be used than in the northern States where the summer temperatures are lower."

Reinforcement for Concrete Pavements

One of the questions submitted to the cities in connection with the Paving Questionnaire in February was: "If concrete is to be reinforced, which will be used, reinforcement bars or fabric, and how many pounds per hundred square feet?"

From the replies received the following information was obtained:

Fabric appeared to be much more popular than bars, although quite a number of cities used the latter. As to weights, there was great diversity in practice. The lightest fabric reported was 28 pounds, except that Girard, O., uses 25 to 35 pounds; Lynchburg, Va., 26 pounds, and Fayetteville, Ark., 25 to 28 pounds. Twenty-eight pounds was reported by Lafayette, Ind; Iron River, Mich., Dayton and Zanesville, O.; while Auburn, Ind., reported 28 to 30. Columbia, Mo., reported 32 to 40 pounds; Fairbury, Neb., and Salt Lake City, 30 pounds, and Fremont, Neb., 31 pounds. Thirty-four pounds was reported by Gary, Ind., and 35 by New Britain, Conn., Aberdeen and Mitchell, S. D., and Barre, Vt. Forty pounds was reported by Florala, Ala.; Benton and Oak Park, Ill.; Decorah and Oelwein, Ia.; Fargo, N. D., and Wisconsin Rapids, Wis. Sioux Falls, S. D., reported 40 to 60 pounds; Lakewood, O., 41 pounds; New Brighton, Pa., 42 pounds; Zion City, Ill., 44 pounds; Waukegan, Ill., and Madison, Wis., 45 pounds. Fifty pounds was reported by Kewanee, Ill.; East Chicago, Lebanon and Vincennes, Ind., and Niagara Falls, N. Y. Fifty to 60 pounds by Homestead, Pa.; 55 pounds by Bellefontaine, O., and 56 pounds by Sandusky, O., College Hill and Lansdowne, Pa., and Clarksburg, W. Va., and 59.32 by Corning, N. Y. Sixty pounds was reported by Frankfort, Ind., Niles and Pontiac, Mich., Gloversville, N. Y., and Lorain, O. Sixty-five pounds was used in Bangor, New Castle, Sayre and Uniontown, Pa. Other cities using fabric but not specifying the weight are: Huntington, Ind., Englewood, N. J., and Clearfield, Pa.

Bars as well as fabric are used by Decorah, Ia.; Fargo, N. D. (fabric for alleys and bars for streets); Lakewood, O. (¾-inch steel bars over trenches); Lorain, O., and Lansdowne, Pa. Bars alone were reported by Lee, Mass. (½-inch bars approximately 100 pounds per hundred square feet); Albion and Owosso, Mich; Fairmont, Minn. (60 pounds); Newton, N. J. (approximately 65 pounds); Mansfield, O. (½-inch steel bars, 2 feet centers); Napoleon, O. (62 pounds); Madison, S. D. (28 pounds), and Yankton, S. D. (36 pounds). Maplewood, Mo., reports medium steel reinforcement not less than .0011 square inch per foot width of street.

Iowa Road Officials Conference

Iowa road officials will hold their eleventh annual conference at the office of the State Highway Commission at Ames on March 19th, 20th and 21st. The conference will be attended by supervisors, engineers, auditors, township trustees and clerks, road superintendents, patrolmen and foremen.

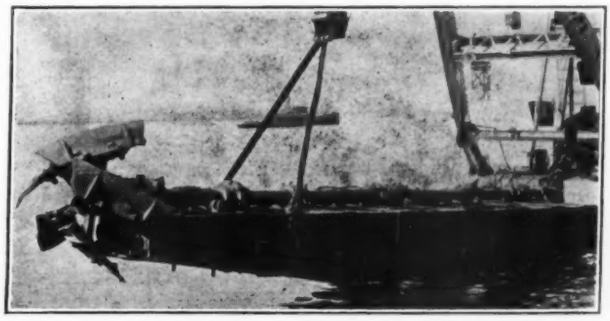
Programs and discussions will be confined to problems of administration, construction and maintenance arising in road work on primary, county and township systems. There will be no display of equipment of any kind and salesmen and agents for equipment are requested not to visit the city during the conference. The conference will be conducted along the same lines as in the past and will be in the nature of a road school, successful engineeers and supervisors leading the discussions.

The State has recently enacted laws under which counties will not be allowed to pay the expenses of their road officials to this conference, and a questionnaire was sent out by the Highway Commission, in reply to which more than 200 road officials indicated their intention to attend and pay their own expenses.

Oakland's Municipal Electric Dredge

The city of Oakland, California, owns and operates an electrically operated dredge which it uses for dredging channels and filling in tidal lands. This it does at prices varying from 5c. per cubic yard in mud to 12c. in hardpan. According to the Oakland Harbor engineer, it is doing this work under unfavorable conditions at half the cost of steam dredges operated by private contractors.

The crew consists of a chief engineer, leverman and eight helpers on board, with two or three additional men attending to the discharge pipe on land. A powerful motor boat rented by the city acts as a tender for the dredge. Power is supplied by the Pacific Gas and Electric Company at a tension of 11,000 volts stepped down to 2,300 volts by means of three 250-kva. transformers located on the stern end of the dredge;



CUTTER OF DREDGE. MOUTH OF SUCTION PIPE IMMEDIATELY BELOW.

a 10-k.w. transformer furnishing a 110-volt supply for lighting purposes. Shore connections are made by a 1,200-foot 3-conductor flexible armored cable which is carried on a special reel on a houseboat in the rear of the dredge, while the houseboat is connected with the power station on shore by the same cable carried on poles 200 feet apart.

The equipment of the dredge consists of a centrifugal suction pump, a cutter driven by a 150-horsepower variable-speed motor, and auxiliary appliances, including spuds for holding the dredge in position. The discharge pipe is 20 inches in diameter and is used in 40-foot sections on pontoons with flexible rubber couplings.

One large piece of work performed by the dredge was the filling in of the site where the Oakland civic auditorium now stands and which was once a marsh. The material for this was discharged through 7,500 feet of pipe line. The average cost of operation of the dredge was about $5,500 per month, which included $2,000 for labor, $2,000 for power and $50 for incidentals. The dredge was operated an average of 20 hours a day and 20 days per month. The cost was about 5c. per cubic yard of material moved. Competitive bids by dredging companies had ranged from 10½c. to 12c. per cubic yard.

Wanaque Reservoir Bids

The development of the Wanaque water supply for communities of northern New Jersey has taken a fresh start during the past few weeks. The list of municipalities that will share in the development has been completed and closed, and a contract let for the completion of the dam. The allotment to the several municipalities is as follows: Newark, 25,000,000 gallons daily; Paterson, 20,000,000; Bayonne, 18,250,000; Kearny, 12,000,000; Passaic, 10.000,000; Clifton, 4,000,000; Bloomfield, 4,000,000; Montclair, 3,000,000; Garfield, 3,000,000; Glen Ridge, 750,000.

This totals 100,000,000 gallons, which is estimated to be the capacity of the water shed and reservoir. Major Arthur H. Pratt, chief engineer of the North Jersey District Water Supply Commission, anticipates a growth of these municipalities which will utilize this total by 1935 or 1940, by which time an additional supply will be necessary.

The contract for completing the dam was awarded on March 10th to Clifford F. MacEvoy & Co., of Newark, N. J., for $3,318,990, more or less. This contract is unusual and the MacEvoy bid even more so.

The contract is of the cost-plus-percentage-fee type. The Commission engineer has prepared an itemized estimate of cost, divided into two classes. Class 1 includes actual net expenditure for labor and animals; rental of plant furnished by the contractor, at 3% per month on a valuation of it, and actual rental paid for additional plant that is rented of others; office expenses; power and fuel used; cost of liability insurance and workmen's compensation insurance; cost of concrete forms and materials used in erecting them. Class 2 includes cost of freight; procuring and transporting labor; of fire and automobile insurance; of materials and tools not included in Class 1; of constructing and removing the necessary buildings and railroad sidings, and removal of existing buildings; and of medical and sanitary services. (These are all defined at length in the specifications.)

The engineers have estimated the Class 1 costs at $2,642,990, and the Class 2 costs at $650,000. Provision is made for modifying these totals in accordance with changes in the estimated quantities and on the basis of the estimated prices; the latter subject to adjustments dependent on changes in wage rates during the progress of the work. Subject to these adjustments, the contractor will receive these sums, plus a 4 per cent fee on Class 2, and plus the fee on Class 1 that he has named in his bid. This fee is therefore the only item on which there was competition in the bids.

There is the further provision that, should the actual cost of Class 1 exceed the estimated cost, the contractor's payment shall be diminished by 25 per cent of this excess to a 10 per cent excess, and by 50 per cent of all additional excess; such deduction, however, not to reduce the fee to less than 3 per cent, or to less than the fee bid if it be less than 3 per cent. On the other hand, should the Class 1 actual cost be less than the estimate, the compensation shall be increased by 50 per cent of the saving.

Five bids were received, one for a fee of 5.94%, two for 3%, one for 2.2%, while one asked no fee whatever. The last, to whom the contract was awarded, explained that he felt so confident of his ability to perform the work below the engineer's estimate that he would accept as his compensation the 50 per cent of the saving that is provided by the contract; plus, of course, the 4% fee on Class 2 (estimated at $26,000) that was fixed by the contract.

The largest items of the engineer's estimate or base cost are: 111,000 cu. yds. of earth excavation at $1.10; 607,000 cu. yds. of general refill and embankment at 80 cents; 207,000 cu. yds. of impervious embankment at $1.50; 63,000 cu. yds. of Class A concrete masonry at $6.25; 11,000 cu. yds. of Class B concrete masonry at $12.00; 19,000 cu. yds. of paving at $7.00; 44,000 cu. yds. of riprap at $2.50; 100,000 barrels of cement at $1.67.

Baltimore to Salvage Refuse

It is reported that the city of Baltimore will construct two refuse salvaging plants, this decision being due chiefly to results obtained at the refuse salvaging plant at Washington, D. C., where tin cans, bottles, scrap metal, etc., which are difficult to dispose of by incineration, are salvaged and sold at a profit. It was calculated that the profit from the sale of waste paper and rags alone would be sufficient to make such a plant profitable in Baltimore.

WATER WORKS MAINS LAID IN 1922

Figures concerning the amount of water mains laid during 1922 by about three hundred and fifty cities were published by us last year. Returns from a number of cities were received after these tables had been compiled, and the figures as to street mains laid in eighty-seven cities are given in the table below.

As in all our tables in recent years, it is seen that only a small number of these cities are served by municipal plants—only 15 per cent in this table. While this may be due party to the greater willingness of municipal water superintendents to answer our questionnaires, other statistics seem to indicate that not more than 30 per cent of the water systems of the country are privately owned.

City	Plant—Municipal (M) or Private (P)	Under 6"	6", 8", 10" and 12"	Over 12"	Other Kinds and Remarks
Arkansas:					
Eureka Springs	M	....	300′	....	700′ of 12" steel mains
California:					
Dinuba	M	....	....	....	2,000′ of 10" steel mains
El Centro	...	....	1,200′	....	None
Lodi	...	....	3,500′	....	All universal
Palo Alto	M	2,557′	None	None	.....
Redding	P	620′	3,580′	6,200′	.....
San Jose	P	14,859′	4,823′	172′	22,525′ of 12" steel mains; 7,406′ over 12" steel mains
Santa Cruz	M	29,727′	4,874′	....	.....
Colorado:					
Delta	M	....	....	....	16,000′ of 12" steel mains
Delaware:					
Laurel	M	2,000′	....	....	.....
Georgia:					
Atlanta	M	550′	70,731′	1,100′	No others
Cedartown	M	4,000′	1,000′	....	No others
Illinois:					
Beardstown	M	3 mi.of 4′	None	None	None
Harvey	P	1,200′	560′	....	1,700′ of 12" steel mains
Hinsdale	M	....	6,000′	....	No others
Rock Island	M	....	1½ mi.	....	.....
Indiana:					
Goshen	M	1,000′	5,000′	....	.....
Michigan City	M	75′ of 4"	12,000′	1,200′	None
Mishawaka	M	1,092′	1,734′	None	None
New Albany	P	....	6,700′	....	None
Iowa:					
Boone	M	1½ mi.	....	....	.....
Kansas:					
McPherson	M	None	600′	....	.....
Kentucky:					
Cynthiana	...	....	700′	....	.....
Danville	M	None	.50 mi.	None	None
Maysville	P	None	1,500′	None	None
Maryland:					
Baltimore	M	4,925′	341,794′	46,185′	No others; 585′ pre-made joints
Massachusetts:					
Lawrence	M	None	5,246′	None	None
Medford	M	408′	6,059′	None	None
Peabody	M	None	1,080′	None	None
Somerville	M	158′	7,408′	None	None
Wareham	M	None	906′	None	All universal
Minnesota:					
Cloquet	M	560′	3,406′	....	.....
Missouri:					
Liberty	M	1,236′	1,548′	None	600′ of 12" steel mains
Montana:					
Billings	M	409′	16,514′	None	None
Red Lodge	M	1,440′	16,600′	None	None
Nebraska:					
Grand Island	...	None	5,900′	....	.....
Lincoln	M	23,313′ of 4"	36,022′	....	.....
Scottsbluff	...	5,415′	4,400′	None	None
New Hampshire:					
Claremont	M	....	160′	None	None
Dover	M	488′ of 4"	950′	....	.....
New Jersey:					
Dover	M	350′	42′	None	None
New York:					
Avon	M	1,000′	None	None	All pre-made joints
Binghamton	M	875′	11,792′	2,919′	.....
Freeport	M	1,000′	....	....	All universal
New York	M	200′	395,000′	42,000′	None
Ossining	M	None	1,700′	None	None
Salamanca	M	....	2,463′	....	None
Watertown	M	1,186′	....	....	.....
Waverly	M	12′ of 4"	1,987′	....	225′ of 2" Byers steel mains
Yonkers	...	None	6,600′	....	.....
Ohio:					
Akron	M	0.22 mi.	16.60 mi.	0.65 mi.	3 mi. lock-bar force main
Bedford	M	None	789′	....	.....
Bowling Green	P	300′	2,850′	None	None
Cleveland	M	1,002′	12,889′	4,698′	1,000′ of 12" steel main; 400′ larger than 12" main
Columbus	M	125′	40,978′	28,533′	None
Dayton	M	1,350′	22,227	None	None
Defiance	M	1,000′	None	None	None
Dennison	P	2,000′	500′	None	None
Eaton	M	700′	....	....	.....
Galion	...	900′	300′	None	.....
Oberlin	M	....	3,000′	None	None
Wadsworth	M	2,300′	None	None	None
Oklahoma:					
Cushing	M	None	3,500′	....	.....
Hominy	M	700′	None	None	None
Oregon:					
Ashland	...	....	....	....	1,000′ of 4" steel mains
Eugene	M	....	....	....	6,000′ of 12" steel mains
Pennsylvania:					
Beaver	M	1,200′ of 4"	....	....	All universal
Chester	P	1,150′	7,345′	None	1,000′ universal
Clearfield	P	Less than 500′	100′	None	Less than 2,000′ steel mains
Coatesville	M	None	1 mi.	None	None
Corry	M	2,000′ of 2"	3,500′	None	2,000′ universal
Freeland	P	4,000′ of 4"	None	None	None
Pittsburgh	M	5,455′	47,185′	797′	.....
Uniontown	P	3,910′ of 4"	None	None	None

PLAIN (Waterbound) MACADAM AND GRAVEL

State and City	Plain (Waterbound) Macadam Laid During 1923		Area Now on Streets	Gravel Laid During 1923	
	Area Now on Streets	Area	Total Cost		Total Cost
Alabama:					
Selma	.....	.....	.....	150,000	.....
Sheffield	.....	.....	.....	.....	25,000	$48,000
Arkansas:					
Fayetteville	50,000	.....	.....	28,000	28,000	29,500[a]
Fort Smith	15 mi.	.....	.....	.....	.....	.....
California:					
Hawthorne	.....	.....	.....	1 mi.	.....	.....
Napa	.....	.....	.....	9.59 mi.	.....	.....
Vallejo	782	.....	.....	.....	.....	.....
Colorado:					
Denver	.....	.....	.....	266,485	.....	.....
Loveland	.....	.....	.....	12 mi.	1 mi.	856
Connecticut:					
Ansonia	2.05 mi.	.....	.....	.....	.....	.....
Bridgeport	15 mi.	.....	.....	.....	.....	.....
Hartford	.....	38,200	$55,800.00[d]	.....	.....	.....
Middletown	38,000	.....	.....	.....	.....	.....
Naugatuck	648 mi.	.....	.....	3.84 mi.	.....	.....
New Haven	146,000	.....	.....	.....	.....	.....
Putnam	10,000	.....	.....	.....	.....	.....
Idaho:					
Pocatello	.....	.....	.....	15 mi.	.....	.....
Illinois:					
Benton	.....	.....	.....	4 mi.	.....	.....
Cairo	.....	.....	.....	115,000	5,000	.....
Maywood	67,000	.....	.....	.....	.....	.....
Oak Park	22.17 mi.	.....	.....	.....	.....	.....
Zion	.....	.....	.....	10 mi.	.....	.....
Indiana:					
Bicknell	.....	.....	.....	4 mi.	.....	.....
Connersville	3 mi.	.....	.....	30 mi.	.....	.....
East Chicago	0.4 mi.	.....	.....	.....	.....	.....
Ft. Wayne	3.15 mi.	.....	.....	.....	.....	.....
Frankfort	54.9 mi.	.....	.....	.....	.....	.....
Gary	10,000	.....	.....	.....	.....	.....
Greensburg	11.77 mi.	.....	.....	.....	.....	.....
Huntington	6,000	.....	.....	8 mi.	.....	.....
Lebanon	.....	.....	.....	46 mi.	.....	.....
Newcastle	1.15 mi.	.....	.....	36 mi.	.....	.....
Peru	19.838 mi.	0.150 mi.	.....	22.447 mi.	.....	.....
Richmond	.....	.....	.....	65.21 mi.	.....	.....
Terre Haute	8.13 mi.	.....	.....	17.80 mi.	.....	.....
Wabash	.....	.....	.....	5,000	1,000	.....
Warsaw	¾ mi.	.....	.....	3 mi.	.....	.....
Washington	.....	.....	.....	2½ mi.	.....	.....
Winchester	.....	.....	.....	.....	.....	.....
Iowa:					
Cedar Rapids	69,872	.....	.....	.....	.....	.....
Cherokee	.....	.....	.....	3 mi.	.....	.....
Decorah	.7 mi.	.....	.....	.2 mi.	.....	.....
Keokuk	30.15 mi.	.....	.....	.....	.....	.....
Kansas:					
Independence	¼ mi.	.....	.....	1 mi.	.....	.....
Kansas City	5.64 mi.	.....	.....	.....	.....	.....
McPherson	.....	.....	.....	24,620	24,620	66,000[e]
Ottawa	1,200	.....	.....	.....	.....	.....
Parsons	16.98 mi.	.....	.....	.....	.....	.....
Kentucky:					
Ludlow	2 mi.	.....	.....	3 mi.	.....	.....
Louisiana:					
Baton Rouge	.....	.....	.....	Ap. 8 mi.	.....	.....
Maine:					
Augusta	.....	.....	.....	.....	10,320	2,050[e]

CAST IRON MAINS LAID IN 1922 (Continued)

City	Plant—Municipal (M) or Private (P)	Under 6"	6", 8", 10" and 12"	Over 12"	Other Kinds and Remarks
Tennessee:					
Greeneville	M	None	500'	None	1 mi. steel main, 12"
Texas:					
Corpus Christie	M	None	11,300'	None	4,000' of pre-made joints
Dallas	M	11,053 mi.	59,440'	2,762'	.....
El Paso	M	4,000' of 2"	28,313'	15,829'	.....
Victoria	M	None	1,120'	None	None
Vermont:					
Burlington	M	802'	1,395'	....	.....
Washington:					
Bellingham	{No. B-M / So. B-P}	2,570'	2,857'	....	All universal pipe
Port Angeles	...	....	....	....	13,050' of 4" to 12" wood
Seattle	...	None	70,420'	8,277'	19,800' larger than 12" steel mains; 13,088' of 12" steel mains
Walla Walla	M	....	....	....	5,250' of 12" steel mains; 2,160' larger than 12" steel mains
Wisconsin:					
Appleton	M	5,168'	17,287'	None	None
Fond du Lac	M	2,934'	4,356'	....	.....
Menominee	...	1,000'	None	None	All centrifugal pipe

Additional Paving Tables

Areas now in use, areas laid during 1923 and the cost thereof, of plain or water-bound macadam, gravel, and concrete pavements as reported last month by several hundred cities.

In the February issue we gave figures for the amounts of sheet asphalt, bituminous concrete, bituminous macadam, rock asphalt, stone block and brick pavements to be found in each of about four hundred cities and the amounts laid by them in 1923, with the cost. In the following tables will be found similar figures for plain or water-bound macadam, gravel, and concrete, both reinforced and not reinforced. In the matter of reinforcement, the kind and weight per unit area used by the different cities will be found on page 93 of this issue.

The decreasing use of plain macadam for city streets is indicated by the fact that, of 113 cities that report having such pavement, only 20 laid any of it last year. Compare this with the bituminous concrete laid by the same cities, 126 of them reporting such pavement in use, and 43 laid new stretches of it last year; or even with gravel, which was in use in 98 cities and laid last year in 37. If actual amounts laid be compared the showing made by water-bound macadam would be still poorer.

Concrete makes the best showing of all, and it is interesting to see the number that are using reinforcement. Not only do more cities report having reinforced than unreinforced concrete pavements, but nearly 50 per cent more report laying reinforced pavement last year than unreinforced.

PLAIN MACADAM AND GRAVEL (Continued)

State and City	Plain (Waterbound) Macadam Area Now on Streets	Laid During 1923 Area	Laid During 1923 Total Cost	Gravel Area Now on Streets	Laid During 1923 Area	Laid During 1923 Total Cost
Massachusetts:						
Arlington	27,800	5,300	9,010.00	290,000	.....	.....
Boston	3,808,955	.....	.....	454,308	.....	.....
Gardner	.....	.....	.....	100,000	40,000	.....
Lowell	538,968	20,394	.....	.....	.....	.....
Newton	.....	.....	.....	148,000	2,100	.....
Pittsfield	.....	.....	.....	55 mi.	.....	.....
Reading	.....	.....	.....	½ mi.	.....	.....
Southbridge	12 mi.	.....	.....	25 mi.	.....	.....
Westfield	8.2 mi.	.....	.....	5 mi.	.....	.....
Worcester	1,283,800	.....	.....	581,620	.....	.....
Michigan:						
Albion	.....	.....	.....	7.6 mi.	4,400	1,111[k]
Ann Arbor	.....	.....	.....	60 mi.	.....	.....
Boyne City	.....	.....	.....	10 mi.	.....	.....
Flint	.....	.....	.....	11 mi.	.....	.....
Greenville	.....	.....	.....	¾ mi.	.....	.....
Holland	.....	.....	.....	12 mi.	.....	.....
Marshall	0.33 mi.	.....	.....	2.5 mi.	.....	.....
Pontiac	20,000	.....	.....	3,000	6,000	.....
Minnesota:						
Duluth	37.63 mi.	.....	.....	67.46 mi.	1.13 mi.	18,700
Faribault	.....	.....	.....	56 mi.	.....	.....
Hibbing	.....	.....	.....	50 mi.	.....	.....
Montevideo	.....	.....	.....	82,000	42,000	2,800
Owatonna	.....	.....	.....	38 mi.	.....	.....
Red Wing	.....	.....	.....	76,377	.....	.....
Rochester	½ mi.	.....	.....	19.26 mi.	.....	.....
Stillwater	Ap. 13,800	.....	.....	.....	.....	.....
Mississippi:						
Clarksdale	.....	.....	.....	80,000	26,000	18,000
Greenwood	.....	.....	.....	17,900	.....	.....
Laurel	.....	.....	.....	100,000	25,000	125,000
Missouri:						
Columbia	½ mi.	.....	.....	1 mi.	.....	.....
Fulton	37,100	.....	.....	137,800	4,000	.....
Monett	10,000	.....	.....	30,000	.....	.....
Sedalia	6¾ mi.	.....	.....	.....	.....	.....
Springfield	.....	.....	.....	0.27 mi.	.....	.....
Montana:						
Butte	0.73 mi.	.....	.....	.....	.....	.....
Havre	.....	.....	.....	4 mi.	.....	.....
Helena	.....	.....	.....	.....	1½ mi.	.....
Nebraska:						
Fairbury	.....	.....	.....	5,000	3,000	3,000[a]
Grand Island	.....	.....	.....	3,000	.....	.....
Norfolk	.....	.....	.....	77,000	.....	.....
New Jersey:						
Bayonne	2 mi.	.....	.....	.....	.....	.....
Englewood	12 mi.	.....	.....	12 mi.	.....	.....
Newark	193,757	.....	.....	.....	.....	.....
Newton	.....	.....	.....	28,000	.....	.....
Nutley	23 mi.	.....	.....	.....	.....	.....
Passaic	32,196	.....	.....	.....	.....	.....
Phillipsburg	10.7 mi.	.....	.....	.....	.....	.....
Plainfield	619,235	.....	.....	.....	.....	.....
Prospect Park	77,600	15,000	.....	.....	.....	.....
Summit	2.75 mi.	1,000	1.25[a]	.....	.....	.....
Trenton	107,693	.....	.....	.....	.....	.....
New Mexico:						
Raton	.....	.....	.....	3 mi.	.....	.....
New York:						
Auburn	46 mi.	.....	.....	.....	.....	.....
Corning	12,074	.....	.....	.....	.....	.....
Cortland	20,000	.....	.....	.....	.....	.....
Geneva	936	.....	.....	.....	.....	.....
Gloversville	.....	.....	.....	.....	2,400	.....
Ithaca	5.79 mi.	.....	.....	.....	.....	.....
Manhattan Boro.	3.5 mi.	.....	.....	.....	.....	.....
Niagara Falls	37,842	.....	.....	.....	.....	.....
Ogdensburg	17 mi.	.....	.....	.....	.....	.....
Perry	4,000	.....	.....	.....	.....	.....
N. Y. (Cont'd):						
Rochester	329,851	.....	.....	29,051	.....	.....
Saranac Lake	10,000	.....	.....	.....	.....	.....
Watertown	30.59 mi.	.59 mi.	$11,750.00[a]	.....	.....	.....
North Carolina:					.....	.....
Asheville	24,700	.....	.....	.....	.....	.....
Durham	5 mi.	.....	.....	.....	.....	.....
Wilmington	14,000	.....	.....	361,000	.....	.....
North Dakota:						
Jamestown	.....	.....	.....	Ap. 1 mi.	3,000	$900
Minot	.....	.....	.....	12 mi.	.....	.....
Ohio:					.....	.....
Akron	149,513	.....	.....	.....	.....	.....
Dayton	.....	.....	.....	.....	11,655	.....
Delaware	9 mi.	.....	.....	.....	.....	.....
Elyria	7 mi.	.....	.....	.....	.....	.....
Galion	2 mi.	.....	.....	.....	.....	.....
Lakewood	0.13 mi.	.....	.....	.....	.....	.....
Lima	.....	4,753	16,073.00[a]	.....	.....	.....
London	.....	.....	.....	20 mi.	.....	.....
Lorain	3.13 mi.	.....	.....	.....	.....	.....
Mansfield	46,000	.....	.....	.....	.....	.....
Napoleon	4 mi.	.....	.....	.....	.....	.....
New Boston	.....	.....	.....	½ mi.	.....	.....
New Philadelphia	.....	.....	.....	10 mi.	.....	.....
Warren	10 mi.	.....	.....	.....	.....	.....
Oklahoma:					16,000	8,000[b]
Ada	.....	.....	.....	.....	.....	.....
Ardmore	.....	.....	.....	2.20 mi.	.....	.....
Bartlesville	5,130	.....	.....	.....	.....	.....
Lawton	.....	.....	.....	20 mi.	5 mi.	10,000
Oregon:						
Astoria	7.15 mi.	.56 mi.	9,291.00[a]	.....	.....	.....
Eugene	.....	3 mi.	25,000.00	.....	1 mi.	5,000
Oregon City	270,000	17,000	80c yd.	.....	.....	.....
Portland	.....	2,269	11,160.00	.....	.....	.....
Pennsylvania:						
Altoona	7,777	.....	.....	.....	.....	.....
Chambersburg	14 mi.	.....	.....	.....	.....	.....
Downington	7.26 mi.	.....	.....	.....	.....	.....
Ellwood City	.....	.....	.....	4,000	.....	.....
Freeland	44,000	4,000	.....	.....	.....	.....
Lansdowne	1 mi.	.....	.....	.....	.....	.....
Luzerne	7 mi.	.13 mi.	1,000.00	.....	.....	.....
Reading	34.565 mi.	.....	.....	.....	.....	.....
Sayre	0.3 mi.	.....	.....	.....	.....	.....
Sewickley	.83 mi.	.....	.....	.....	.....	.....
South Carolina:						
Greenville	2,670	.....	.....	2 mi.	2 mi.	8,000[a]
South Dakota:						
Madison	.....	.....	.....	2½ mi.	.....	.....
Mitchell	.....	.....	.....	22,140	.....	.....
Yankton	.....	.....	.....	1½ mi.	1½ mi.	.....
Tennessee:						
Clarksville	20 mi.	.....	.....	.....	.....	.....
Jackson	.....	.....	.....	250,000	100,000	100,000
Kingsport	31,000	.....	.....	.....	.....	.....
Nashville	175 mi.	5 mi.	.....	.....	.....	.....
Texas:						
Brownwood	211,200	23,467	5,800.00	140,800	22,245	2,900
Houston	.....	.....	.....	1,998,631	276,864	205,538[a]
Longview	1 mi.	.....	.....	5 mi.	.....	.....
Palestine	.....	.....	.....	5,000	3,000	5,000[l]
Taylor	.....	.....	.....	25 mi.	5 mi.	.....
Weatherford	.....	.....	.....	100 mi.	.....	.....

PLAIN MACADAM AND GRAVEL (Continued)

State and City	Plain (Waterbound) Macadam: Area Now on Streets	Laid During 1923: Area	Laid During 1923: Total Cost	Gravel: Area Now on Streets	Laid During 1923: Area	Laid During 1923: Total Cost
Utah:						
Logan	2 mi.	2 mi.	.....	5.5 mi.	2 mi.	2,673
Salt Lake City	1.397 mi.	.....	.....	.....	.....	.....
Vermont:						
Barre	2.0 mi.	.....	.....	3.03 mi.	.....	.....
Virginia:						
Danville	11,857	.....	.....	.....	.....	.....
Lynchburg	70,000	20,000	.....	.....	.....	.....
Salem	.....	.....	.....	.....	1 mi.	6,000
Suffolk	.....	1,111	.....	14,801	7,575	3.25
Winchester	734	.....	.....	40,970	2¼ mi.	.....
Washington:						
Aberdeen	.....	.....	.....	17 mi.	1.3 mi.	33,000
Port Angeles	.....	0.95 mi.	.....	3.39 mi.	.....	.....
West Virginia:						
Fairmont	23,000	.....	.....	.....	.....	.....
Wisconsin:						
Appleton	15,000	.....	.....	11,000	.....	.....
Beloit	4,000	.....	.....	2,000	.....	.....
Fond du Lac	26,000	.....	.....	.....	.....	.....
Green Bay	111,714	.....	.....	13.97 mi.	.....	.....
Kaukauna	20,000	.....	.....	.....	.....	.....
Madison	617,251	.....	.....	.....	.....	.....
Marinette	2.2 mi.	.....	.....	.....	.....	.....
South Milwaukee	.....	.....	.....	.....	27,800	.....
Wausau	20 mi.	.....	.....	10 mi.	.....	.....
Wyoming:						
Sheridan	.....	.....	.....	3,900	.....	.....

*Per yard. [a]Includes entire pavement. [b]Includes entire improvement. [c]Includes surface and base. [d]Includes surface, base and grading. [e]Includes surface, base and curb. [f]Includes surface, base, grading, curb. [g]Includes surface, base, grading, curb, sewers. [h]Resurfacing. [i]Surface only. [j]Surface, base, grading, sewers. [k]Surface, base, grading, curb, gutter, sewers. [l]Surface, base, curb and gutter.

PLAIN AND REINFORCED CONCRETE

State and City	Plain Concrete: Total area now on streets	Plain Concrete: Laid During 1923 Amount	Plain Concrete: Laid During 1923 Total cost	Reinforced Concrete: Total area now on streets	Reinforced Concrete: Laid During 1923 Amount	Reinforced Concrete: Laid During 1923 Total cost
Alabama:						
Birmingham	160,892	6,095	$12,314.00[p]	.....	.....	.....
Selma	65,000	13,000	30,000.00	.....	.....	.....
Arkansas:						
Fayetteville	.....	.....	.....	6,000	6,000	$16,500[a]
Fort Smith	24 mi.	.....	.....	½ mi.	.....	.....
California:						
Glendale	937,976	16,798	3,108.00[l]	.....	.....	.....
Hawthorne	2 mi.	1 mi.	24,000.00[l]	.....	.....	.....
Napa	1.43 mi.	5,000	16,800.00[m]	.....	.....	.....
Orange	101,667	78,000	183,748.00[m]	.....	.....	.....
Palo Alto	175,217	61,000	105,000.00[b]	.....	.....	.....
Pittsburg	40,556	16,223	33,399.00[r]	.....	.....	.....
Santa Barbara	9.4 mi.	28,416	74,948.00[j]	.....	.....	.....
So. Pasadena	40,667	2,056	5,000.00[m]	.....	.....	.....
Vallejo	23,689	2,133	6,491.00	.....	.....	.....
Colorado:						
Denver	995,450	174,300	357,600.00	.....	.....	.....
Longmont	75,000	.....	.....	17,000	.....	.....
Loveland	30,500	.....	.....	31,600	31,600	78,900

PLAIN AND REINFORCED CONCRETE—(Cont.)

State and City	Plain Concrete: Area Now on Streets	Plain Concrete: Laid During 1923 Area	Plain Concrete: Laid During 1923 Total cost	Reinforced Concrete: Area Now on Streets	Reinforced Concrete: Laid During 1923 Area	Reinforced Concrete: Laid During 1923 Total Cost
Kentucky:						
Covington	.....	.....	.....	20,000	10,000	3.25*[a]
Ft. Thomas	.....	.....	.....	.....	13,127	32,817
Ludlow	.....	.....	.....	7,000	.....	.....
Maryland:						
Salisbury	11,000	.....	.....	.....	.....	.....
Massachusetts:						
Arlington	23,520	6,500	20,670.00	.....	.....	.....
Boston	29,149[a]	.....	.....	.....	.....	.....
Brockton	.....	6,670	26,000.00	.....	8,800	28,000
Gardner	.....	.....	.....	30,000	6,000	.....
Lee	.....	.....	.....	.....	⅝ mi.	34,200[a]
Lowell	16,367	.....	.....	22,438	12,673	.....
Lynn	270,804	.....	.....	.....	.....	.....
Newton	.....	.....	.....	2,131	2,131	9,500
Pittsfield	60,614	.....	.....	40,287	13,203	46,210[m]
Southbridge	12,000	.....	.....	1,000	.....	.....
Westfield	.....	.....	.....	9,986	.....	.....
Worcester	43,187	2,998	9,900.00	13,574	7,410	33,365[a]
Michigan:						
Albion	.....	.....	.....	3,800	3,800	1.70 per yd.[r]
Alma	7 mi.	.....	.....	.....	.....	.....
Ann Arbor	146,245	.....	.....	.....	.....	.....
Battle Creek	.....	.....	.....	4,179	4,179	8,483[d]
Boyne City	49,200	.....	.....	12,000	.....	.....
Coldwater	.....	.....	.....	.....	6,800	17,000
Detroit	34,700	.....	.....	.....	.....	.....
Dowagiac	40,000	10,000	20,000.00	.....	.....	.....
Flint	3.24 mi.	857	4,300.00[b]	.....	.....	.....
Greenville	.....	.....	.....	8 blocks[a]	.....	.....
Hamtramck	53,664	.....	.....	295,669	43,733	.....
Hastings	68,326	12,600	22,050.00	.....	.....	.....
Holland	4,700	.....	.....	.....	.....	.....
Iron River	17,300	.....	.....	17,300	.....	.....
Lansing	3 mi.	.....	.....	.....	.....	.....
Marshall	0.75 mi.	.....	.....	.....	.....	.....
Mt. Pleasant	65,962	8,923	17,489.00	.....	.....	.....
Owosso	.....	.....	.....	2.5 mi.	30,000	75,000[l]
Pontiac	.....	.....	.....	22,700	8,250	26,780
Minnesota:						
Cloquet	35,000	6,695	.....	.....	.....	.....
Duluth	2.66 mi.	.....	.....	52.01 mi.	7.63 mi.	565,000
Fairmont	3,333	.....	.....	16,310	6,399	25,169[b]
Faribault	.....	.....	.....	.62 mi.	.....	.....
Hibbing	.....	.....	.....	19,200	.....	.....
Little Falls	.....	.....	.....	36,000	.....	.....
Minneapolis	370,844	35,736	.....	.....	131,609.00[d]	.....
Owatonna	2,000	.....	.....	.....	.....	.....
Red Wing	.....	.....	.....	78,470	45,431	108,048
Rochester	58,998	.....	.....	.....	.....	.....
St. Cloud	.....	.....	.....	23,900	2,300	.....
Stillwater	4,110	.....	.....	7,343	.....	.....
Willmar	.....	.....	.....	77,000	.....	.....
Mississippi:						
Biloxi	.....	.....	.....	10,000	10,000	.....
Clarksdale	.....	250	500.00	.....	.....	.....
Hattiesburg	.....	.....	.....	5,313	2,976	.....
Laurel	3,000	2,000	4,700.00	.....	.....	.....
Missouri:						
Cape Girardeau	10 mi.	.....	.....	.....	.....	.....
Carthage	140,000	28,500	65,572.00	.....	.....	.....
Columbia	2½ mi.	.....	.....	.....	½ mi.	.....
Joplin	.....	17,585	37,375.00	.....	.....	.....
Kansas City	2,437,321	257,156	779,070[d]	.....	.....	.....
Maplewood	.....	.....	.....	100,574	41,042	129,676[r]
Nevada	2 mi.	½ mi.	20,000.00	.....	.....	.....
St. Joseph	.....	82,441	250,031.00	.....	.....	.....
Sedalia	5⅛ mi.	13,075	27,511.00[m]	.....	.....	.....
Springfield	24.5 mi.	1.2 mi.	37,334.00[d]	.....	.....	.....

Connecticut:						
Ansonia	2.05 mi.			26 mi.		
Bridgeport	85,000					
Danbury		8,400	26,000.00			
Hartford	75,227	7,387	24,338.00[j]	5,610	5,610	17,323[j]
Meriden	283	283	878.00	55,055		
Middletown				25,670		
Naugatuck				.733 mi.		
New Britain	13,013	1,013	2,918.00[a]	16,966	7,597	23,933[a]
New Haven	27,500[a]					
Putnam	10,000			10,000		
Shelton	3,000			3,000		
Idaho:						
Pocatello	4,700					
Illinois:						
Benton				15 mi.	2 mi.	104,000[i]
Bloomington	3,440			44,869	22,267	81,003
Canton		1,200	2,100.00	7,600	3,800	14,120
Galena	670					
Granite City					31,000	125,000
Kewanee	845					
La Grange					25,000	120,000
Maywood				17,000	36,880	151,000
Normal				18,415	7,000	35,000
Oak Park	16.51 mi.	5.09 mi.	179,960.00[c]	.42 mi.	.112 mi.	9,400[c]
Pana					14,300	56,000[i]
Sycamore					15,000	51,000
Waukegan					22,985	101,133[b]
Zion	10,600			20,000		
Indiana:						
Anderson		25,905	76,423.00[k]			
Auburn				1 mi.		
Bicknell	¼ mi.					
Brazil	3,000					
Connersville	5,475	23,486	61,299.00	164,740		
East Chicago				26 mi.	3½ mi.	280,000
Elkhart	23,423	15,500	51,000.00[a]			
Fort Wayne	0.8 mi.	0.8 mi.	22,359.00[c]	1.9 mi.		
Frankfort				1.73 mi.		
Gary	537,000[a]	89,000[a]	3.25			
Huntington	1.47 mi.					
Lafayette				2.45 mi.	.81 mi.	35,446
Lebanon				10,000	4,000	
Newcastle	105,000	40,000				
Peru				2.04 mi.		
Portland	100,000	8,202	25,375.00[a]	45,000	3,248	11,448[a]
Richmond	4 mi.			5.033 mi.	0.713 mi.	35,271[d]
Rushville				⅛ mi.		
Terre Haute	11.59 mi.[a]	1.18 mi.[a]	78,792.00[a]			
Warsaw	8,000	8,000	18,000.00	7,000	7,000	19,000
Washington	16,000	4,427	12,615.00[d]			
Winchester				1,500	500	
Iowa:						
Ames				150,000	80,000	232,000[a]
Cedar Rapids	164,619	10,377	26,818.00			
Cherokee	¾ mi.			½ mi.		
Decorah				2 mi.	13,728	34,594[d]
Eagle Grove	72,500					
Keokuk	6.72 mi.					
Le Mars	89,008	108,432	330,972.00			
Muscatine		15,300	37,001.00[m]			
Oelwein				7,000		
Sioux City	115.15 mi.	180,025	413,360.00	2 mi.	21,390	47,795
Kansas:						
Emporia	1,600			3,400		
Independence	5 mi.	½ mi.				
Kansas City	36.52 mi.	106,916	169,052.00			
Manhattan	14,175	2,000	4,477.00[a]			
Newton				9,910		
Ottawa	3,000					
Parsons	1,591	1,591	4,212.00[d]			

Montana:						
Bozeman	2,679					
Butte	0.8 mi.			0.186 mi.	3,604	13,052[b]
Helena	1¼ mi.					
Kallspell	9,670			6,800		
Livingston	200.000					
Nebraska:						
Fairbury	1,000	500	1,250.00[a]			
Fremont	20,000					
Grand Island	13,015	928	2,163.00[a]			
Kearney	1½ mi.					
Lincoln	36,816	6,461	14,500.00[b]			
Norfolk	48,253					
New Jersey:						
Bayonne	¼ mi.					
Hammonton				5¾ mi.	9,180	23,501
Newark	56,663					
New Brunswick	107.000					
Newton				22,500	5,200	16,800
Nutley	23 mi.			0.6 mi.		
Orange	534					
Passaic	2,384					
Phillipsburg	.12 mi.			1.88 mi.		
Plainfield	13,540			27,354		
Prospect Park	23,000					
Rahway				8,000	8,000	48,800[f]
South Orange					2,900	
Summit	0.2 mi.					
Trenton	43,554	1,574		6,932		
New Mexico:						
Albuquerque	2.2 mi.					
Raton	18,000					
New York:						
Auburn				35,494	10,587	43,636[b]
Corning	1,376			23,160		
Geneva				12,647		
Gloversville				12,610[a]	6,507	28,679[c]
Hempstead				1½ mi.		
Islip, Brookhaven, Patchogue & Bellport	6 mi.			4 mi.		
Ithaca	.50 mi.			.10 mi.		
Little Falls	5,433			32,174	4,678	22,852[m]
Lockport	140,827	6,706	8,140.00			
Lynbrook	2,000			114,200	60,200	175,000[b]
New York (Manhattan Boro)				0.5 mi.		
Niagara Falls	33,657	12,569	77,067.00[b]			
Norwich				32,971		
Ogdensburg				3,453		
Oneida	1.40 mi.					
Oneonta				.41 mi.	.16 mi.	6,811[c]
Perry				13,100	12,900	45,000
Port Jervis				12.861	8,605	
Rochester	1,513					
Saranac Lake	1,400			1,100	1,100	
Watertown	6.98 mi.	.78 mi.	61,500.00[d]			
North Carolina:						
Asheville	120,511	32,155				
Charlotte	21,855					
Durham	1,000			4,000		
Wilmington	11,900					
North Dakota:						
Fargo				31,422	1,318	4,319[a]
Jamestown				5,400		
Ohio:						
Akron				61,868	725	3,375[a]
Alliance				1 mi.		
Bellefontaine					5,583	14,021
Columbus		78,370	237,536.00			

PLAIN AND REINFORCED CONCRETE—(Cont.)

State and City	Plain Concrete: Area Now on Streets	Plain Concrete: Laid During 1923 Area	Plain Concrete: Laid During 1923 Total cost	Reinforced Concrete: Area Now on Streets	Reinforced Concrete: Laid During 1923 Area	Reinforced Concrete: Laid During 1923 Total Cost
Ohio (Continued)						
Dayton	.....	.....	.....	3.65 mi.	34,773	104,319
Delaware	.....	.....	.....	.25 mi.	.....	.....
Elyria	.....	.....	.....	0.3 mi.	.....	.....
Findlay	.6 mi.	.....	.....	.....	2,300	28,463
Galion	.....	.....	.....	.....	1,058	2,454
Girard	.....	.....	.....	6,930	.....	.....
Lakewood	.....	.....	.....	3.73 mi.	.....	.....
Lima	.....	.....	.....	6,742	1,626	7,352[k]
Lorain	3.18 mi.	.....	.....	8.28 mi.	2.6	145,583
Mansfield	11,000	5,700	22,100.00[w]	10,000	.....	.....
Napoleon	.....	.....	.....	14,078	4,718	11,087
Newark	.....	860	2,000.00[a]	.....	.....	.....
Sandusky	.....	.....	.....	120,000	5,000	.....
Warren	.....	.....	.....	6,578	6,578	.....
Zanesville	500	500	1,825.00[a]	.7 mi.	.....	.....
Oklahoma:						
Ada	.....	4,000	16,000.00[x]	.....	.....	.....
Ardmore	1.12 mi.	.72 mi.	50,314.00[v]	1.08 mi.	.....	.....
Bartlesville	199,820	5,500	25,000.00	.....	.....	.....
Blackwell	22,500	22,500	.....	.....	.....	.....
Henrietta	10,800	1,400	3,500.00[c]	.....	.....	.....
Lawton	1 mi.	.....	.....	.....	.....	.....
Oregon:						
Astoria	4.85 mi.	.92 mi.	43,577.00[j]	.....	.....	.....
Eugene	.....	20,000	80,000.00	.....	.....	.....
Marshfield	51,100	22,710	59,046.00[d]	.....	.....	.....
Oregon City	14,000	.....	.....	3,730	1,800	2.45*
Portland	1,121,390	152,877	435,458.00	.....	.....	.....
Salem	389,707	45,013	103,281.00	.....	.....	.....
Pennsylvania:						
Altoona	.....	.....	.....	123,041	46,138	180,997[f]
Bangor	.....	.....	.....	30,464	15,840	.....
Chambersburg	.....	.....	.....	600 ft.	.....	.....
Clairton	.....	.....	.....	50,000	.....	.....
Clearfield	.....	.....	.....	0.57 mi.	1,000	4.00**
College Hill	.....	.....	.....	17,437	9,477	38,900[m]
Downington	.....	.....	.....	33,000	.....	.....
Dubois	.....	.....	.....	35,080	7,253	37,954[b]
Duquesne	.....	.....	.....	.41 mi.	.....	.....
Freeland	.....	.....	.....	3,600	.....	.....
Hollidaysburg	.....	.....	.....	9,000	.....	.....
Homestead	.....	.....	.....	6,825	5,663	15,295[c]
Lansdowne	.....	.....	.....	1½ mi.	11,500	35,000[d]
Lebanon	2,876	.....	.....	45,200	18,403	49,446
Monongahela	.....	.....	.....	1,100	.....	.....
Nazareth	.....	.....	.....	1.2 mi.	.....	.....
New Brighton	.....	.....	.....	.....	5,840	15,896
New Castle	.....	.....	.....	4.37 mi.	1.751 mi.	111,117[g]
Reading	.162 mi.	.....	.....	.....	.....	.....
Sayre	.....	.....	.....	Ap. 1¼ mi.	.....	.....
Sharon	.....	.....	.....	2,602	.....	.....
Slatington	.....	.....	.....	.4 mi.	.....	.....
Williamsport	.09 mi.	.....	.....	.....	.....	.....
Rhode Island:						
Lincoln	.....	.....	.....	.....	3 mi.	155,000
South Carolina:						
Greenville	18,000	9,000	85,000.00[g]	.....	.....	.....
South Dakota:						
Madison	.....	.....	.....	7,000	7,000	2.99*
Mitchell	.....	.....	.....	428,085	71,408	183,330
Sioux Falls	53,353	.....	.....	159,732	125,902	299,027[m]
Watertown	23,337	.....	.....	26,412	13,632	45,575
Yankton	77,897	.....	.....	25,335	.....	.....

PLAIN AND REINFORCED CONCRETE—(Cont.)

State and City	Plain Concrete: Area Now on Streets	Plain Concrete: Laid During 1923 Area	Plain Concrete: Laid During 1923 Total cost	Reinforced Concrete: Area Now on Streets	Reinforced Concrete: Laid During 1923 Area	Reinforced Concrete: Laid During 1923 Total Cost
Tennessee:						
Jackson	4,860	800	1,600.00	.....	.....	.....
Kingsport	12,000	.....	.....	.....	.....	.....
Nashville	3,000	.....	.....	.....	.....	.....
Texas:						
Cisco	.....	.....	.....	10,000	.....	.....
Houston	25,370	8,684	35,667.00[a]	.....	.....	.....
Palestine	14,500	.....	.....	.....	.....	.....
Paris	9,019	.....	.....	.....	.....	.....
Utah:						
Logan	21,762	.....	.....	102,464	.....	.....
Murray	72,100	.....	.....	.....	.....	.....
Salt Lake City	11.458 mi.[s]	0.235 mi.[s]	.....	.....	.....	.....
Vermont:						
Barre	.95 mi.[s]	6,460*	20,530.00[a]	.....	.....	.....
Newport	.....	.....	.....	11,500	.....	.....
Virginia:						
Danville	18,023	.....	.....	.....	.....	.....
Lynchburg	.....	.....	.....	27,000	10,500	.....
Petersburg	4,690	.....	.....	1,900	.....	.....
Suffolk	.....	15,100	34,730.00	.....	.....	.....
Washington:						
Aberdeen	200,000	32,000	130,000.00	.....	.....	.....
Anacortes	.....	32,000	89,001.00	.....	.....	.....
Port Angeles	44,191	.....	.....	.....	.....	.....
Walla Walla	9,000	.....	.....	.....	.....	.....
Yakima	108,878	.....	.....	.....	.....	.....
West Virginia:						
Bluefield	.....	.....	.....	7,403	1,083	2,954[a]
Clarksburg	1 mi.	.....	.....	4 mi.	30,600	179,400[g]
Fairmont	30,300	2,600	3.00*	.....	.....	.....
Wisconsin:						
Appleton	9,100	.....	.....	7,250	.....	.....
Beloit	.....	.....	.....	202,301	89,656	196,002
Fond du Lac	263,927[s]	.....	.....	.....	.....	.....
Green Bay	7,502	1,642	3,768.00	74,407	5,533	15,903
Kaukauna	.....	.....	.....	15,494	.....	.....
Madison	.....	.....	.....	231,298	49,992	112,500[c]
Marinette	.....	.....	.....	66,000	.....	.....
Rice Lake	.....	.....	.....	22,000	.....	.....
South Milwaukee	4. mi.	1 mi.	86,300.00[f]	.....	.....	.....
Wausau	150,000	15,000	41,000.00	2,000	.....	.....
Wisconsin Rapids	130,000	10,000	2.28**	60,000	20,000	2.40**
Wyoming:						
Sheridan	3,888	.....	.....	.....	.....	.....

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* Per square yard. [a] Includes entire pavement. [b] Entire improvement. [c] Includes surface and base. [d] Surface, base and grading. [e] Includes surface, base and curb. [f] Surface, base, grading, curb. [g] Includes surface, base, grading, curb and sewers. [h] Resurfacing. [i] Surface only. [j] Surface, base, grading, sewers. [k] Surface, base, grading, sewers, curbs and sidewalks. [m] Surface, grading. [n] Base, grading. [p] Includes 5- and 6-in. concrete base. [r] Surface, grading and curb. [s] Includes plain and reinforced concrete. [t] Surface, base, grading, curb, engineering. [u] Entire improvement except curb, including engineering. [v] Surface, base, grading, curb and gutter. [w] All except sidewalk [x] Surface, grading, draining, curb, water connections, concrete.

Recent Legal Decisions

SALE OF BONDS HELD CONDITION PRECEDENT IN PAVING CONTRACT

The contract of a municipal paving district for the construction of a pavement provided that the contractor, who was to be paid in cash, should begin work within 15 days after receipt of notice that the district commissioners had sold the bonds for the improvement and had in hand funds to pay the contractor's monthly estimates. A question having arisen as to the construction of the statute authorizing the issue of the bonds, the commissioners were unable to sell them, although they made diligent efforts to do so. The Circuit Court of Appeals, Eighth Circuit, holds, Moreno-Burkham Const. Co. v. Burganer, 289 Fed. 718, that the performance of the contract was conditioned upon the sale of the bonds and the district was not liable for its breach.

USE OF PATENTED MATERIALS DOES NOT PREVENT COMPETITIVE BIDDING

The New York Supreme Court, Monroe County, holds, Adam v. Van Zandt, 199 N. Y. Supp. 225, that there may be a proper competition in biddings for a municipal contract, although a very considerable part of the necessary material is controlled by a monopoly, so called, by authority of a patent. And where the charter of the city of Rochester authorized the abutting owners petitioning for a street paving improvement to designate one of the various kinds of pavement specified as proper by the common council, the designation of a patent pavement was not improper, where before the bids were submitted, the owners of the patent bound themselves to furnish their commodity at a specified price, to whomever was awarded the contract, for which they themselves were among the unsuccessful bidders. The court followed the case of Whitmore, Rauber & Vicinus v. Edgerton (the bitulithic pavement case), 87 Misc. 216, 149 N. Y. Supp. 808, affirmed 167 App. Div. 960, 152 N. Y. Supp. 1149, which decides, among other things, that the adoption of specifications, which include a requirement that a patented substance be used for the top dressing of a pavement does not prevent competitive bidding.

CONTRACTOR'S SURETY ONLY ENTITLED TO SUBROGATION WHERE FUNDS, ETC. REQUIRED TO BE WITHHELD FOR CREDITORS

The Washington Supreme Court holds, United States Fidelity & Guaranty Co. v. Ryan, 214 Pac. 433, that when, by the terms of a public improvement contract, the state or municipality is clearly required to withhold funds applicable to the payment of the contractor as a trust fund for the payment of those furnishing labor and supplies, giving to such persons preferred claims against such funds superior to that of the contractor, a surety of the contractor having paid such preferred claims, is entitled to the portion of such funds that the persons whose claims it so pays were entitled to; but when, by the terms of a public improvement contract, the state or municipality is not clearly required so to withhold funds applicable to the payment of the contractor, but is merely given an option to do so, one who may pay those furnishing labor and supplies upon the work does not acquire any such preferred claim against the fund which may remain in the hands of the state or municipality applicable to the payment of the contractor.

A state which has the option, under the contract, to take over the equipment and supplies of the contractor and finish the construction of a highway on the contractor's failure to do so promptly, is not obliged to take over the contractor's equipment and supplies, on his default, for the benefit of the surety.

COURT MAY NOT WITHHOLD SUMS PAYABLE UNDER CONTRACT TO PAY SUBCONTRACTORS, ETC.

The Mississippi Supreme Court holds, First Nat. Bank v. Monroe County, 95 So. 726, that laborers, materialmen and subcontractors have no lien against the state or any subdivision thereof for labor or material furnished on any public work, and where a contract for the construction of a public road provided that 85 per cent. of the engineer's monthly estimate of the value of the work done would be paid to the contractor as the work progressed, in the absence of a lien or contractual authority for so doing, the county had no right to withhold this monthly payment for the purpose of paying the claims of laborers, materialmen, or subcontractors.

CHARTER POWER HELD TO INCLUDE LAYING SIDEWALK BUT NOT ESTABLISHMENT OF GRADE BY LOT OWNER

The West Virginia Supreme Court of Appeals holds, Fry v. City of Ronceverte, 117 S. E. 140, that the municipal authorities of Ronceverte are without power, under the city charter, to charge an abutting landowner the expense of establishing a grade for a sidewalk by excavating a hill, or making an embankment, and building a retaining wall; but they have power to require such owner to lay a sidewalk after the grade has been established, and on his failure to do so they may lay the sidewalk and charge him with the expense.

CITY AUTHORITIES JUDGES OF WHAT IS A PUBLIC NUISANCE—DECAYING AND DANGEROUS BUILDINGS

The Oklahoma Supreme Court, Calkins v. Ponca City, 214 Pac. 188, holds that an ordinance declaring two frame buildings to be public nuisances because of their unsafe and unsanitary condition is neither unreasonable nor arbitrary. The authority of the city to declare a public nuisance is a delegation of police power, primarily lodged in the state, in order that it may be more effectively exercised by officers locally ac-

quainted with the necessities of the particular community. If it appears that the question of a nuisance or not is one in which there might be an honest difference of opinion in impartial minds, the action of the city authorities is held conclusive of the question.

MUNICIPALITY HELD NOT LIABLE FOR ERRORS OF JUDGMENT OF OFFICERS IN PLANNING SEWERAGE SYSTEM

The Georgia Court of Appeals holds, City of Albany v. Maclin, 117 S. E. 100, that a municipality is not liable for drainage to property resulting from an error of judgment of its proper officials in planning a sewerage drainage system for the city, or in altering the plan first adopted. The error of judgment which was here the proximate cause of the drainage sued for, was the substitution of a gasoline motor for an electric motor in the pumping plant, causing overflow on adjoining property.

CITY LIABLE IN PROPRIETARY CAPACITY FOR NEGLIGENCE IN CONSTRUCTION OF JOINT IN WATER PIPE

The Iowa Supreme Court holds, Miller Grocery Co. v. City of Des Moines, 192 N. W. 306, that the negligence of a city in the construction and maintenance of a defective joint between a street hydrant and a water pipe, used in its dual governmental and proprietary capacity as part of the fire apparatus of the city and also for the sale of water to the inhabitants, would make the city liable for damages in its proprietary capacity, in the event of an escape of water overflowing and injuring neighboring property. Where the evidence showed that the water pipe was not properly closed and that the joint where it was attched to the hydrant was defective, the question whether the city in its proprietary capacity was negligent in the construction of the joint, was for the jury.

MATERIAL ALTERATION OF CONTRACT FOR DITCH DISCHARGING SURETY

The Iowa Supreme Court holds, Holland v. Story County, 192 N. W. 402, that a change in the plans and specifications for a drainage ditch requiring the construction of the ditch for 1,300 feet parallel with and at a distance from the original line of one rod, at an additional cost of $760, after the digging on the original line had been begun, was a material alteration of the contract, discharging the surety thereon. When the surety, on the discharge of the contractor, entered into an agreement with the county to complete the improvement, in ignorance of this alteration and of outstanding claims filed in the ditch proceedings, it was held the contract by the surety was without consideration, and did not bind him.

CONTRACTOR EXCAVATING PUBLIC DRAINAGE DITCH HELD TO REASONABLE CARE TO PREVENT OVERFLOWING LAND

The North Dakota Supreme Court holds, Weller v. Mulgrew & Sons Co., 192 N. W. 969, that a contractor who is engaged in excavating a public drainage ditch must use, in the performance of his contract, reasonable care so as to avoid injury to adjacent lands. Where he has obstructed and filled up an old road ditch, which served to drain flood waters in the territory tributary, and after a heavy rain flood waters in the road ditch, by the obstruction, were cast upon the plaintiff's land, the failure of the contractor, who was advised by the chairman of the drainage commission to use his own judgment in the prosecution of the work, to exercise reasonable care, would make him liable to the plaintiff for injury to the land.

A right of way granted by the plaintiff to the drainage commission for the construction of the drainage ditch, and the release therein of all claims to damages from the laying out, construction and maintenance thereof through plaintiff's land, did not release damages which might be caused by the plaintiff's own negligence.

It was for the jury to determine how far the extraordinary rains absolved the contractor from liability.

HIGHWAY SUBCONTRACTORS LIABLE FOR BREACH OF CONTRACT IRRESPECTIVE OF CONTRACTOR'S BOND

In an action for breach of contract by a highway contractor against subcontractors for the surfacing, it was objected that many of the items allowed by the trial court were nonlienable against the contractor's bond. The Washington Supreme Court holds, Adams County v. Sloane, 215 Pac. 356, that a subcontractor is bound by his own contract, and not by the terms of his principal's bond. If he breaches his contract by failing to furnish the items he agrees to furnish and his principal is compelled to furnish them, the principal recovers because of the breach of the contract, not on the theory that the items furnished are lienable.

NO GROUNDS SHOWN TO ENJOIN MUNICIPAL CONTRACT TO INSTALL INCINERATOR BY COMPETITIVE BIDS

The board of city commissioners of Tulsa approved plans and specifications submitted by the city engineer which provided that the city desired to purchase a first-class garbage and refuse destructor to burn 40 tons of mixed refuse per 12-hour day, and described the kind of material in detail of which the plant must be constructed, giving all qualified manufacturers the right to bid upon the proposed proposition. The evidence in an action to enjoin the construction of the plant showed that all modern incinerator plants are patented, and that pursuant to notice given by the city for bids, six different manufacturing concerns submitted bids for the installation of such an incinerator plant as would meet the plans and specifications approved by the city. No fraud was shown in awarding the contract to the successful bidder. The Oklahoma Supreme Court held, Woolsey v. City of Tulsa, 216 Pac. 126, that the board substantially complied with the city charter provisions requiring plans and specifications and competitive bidding, and no injury being shown to have resulted to the plaintiffs in the action, no grounds for equitable relief were established.